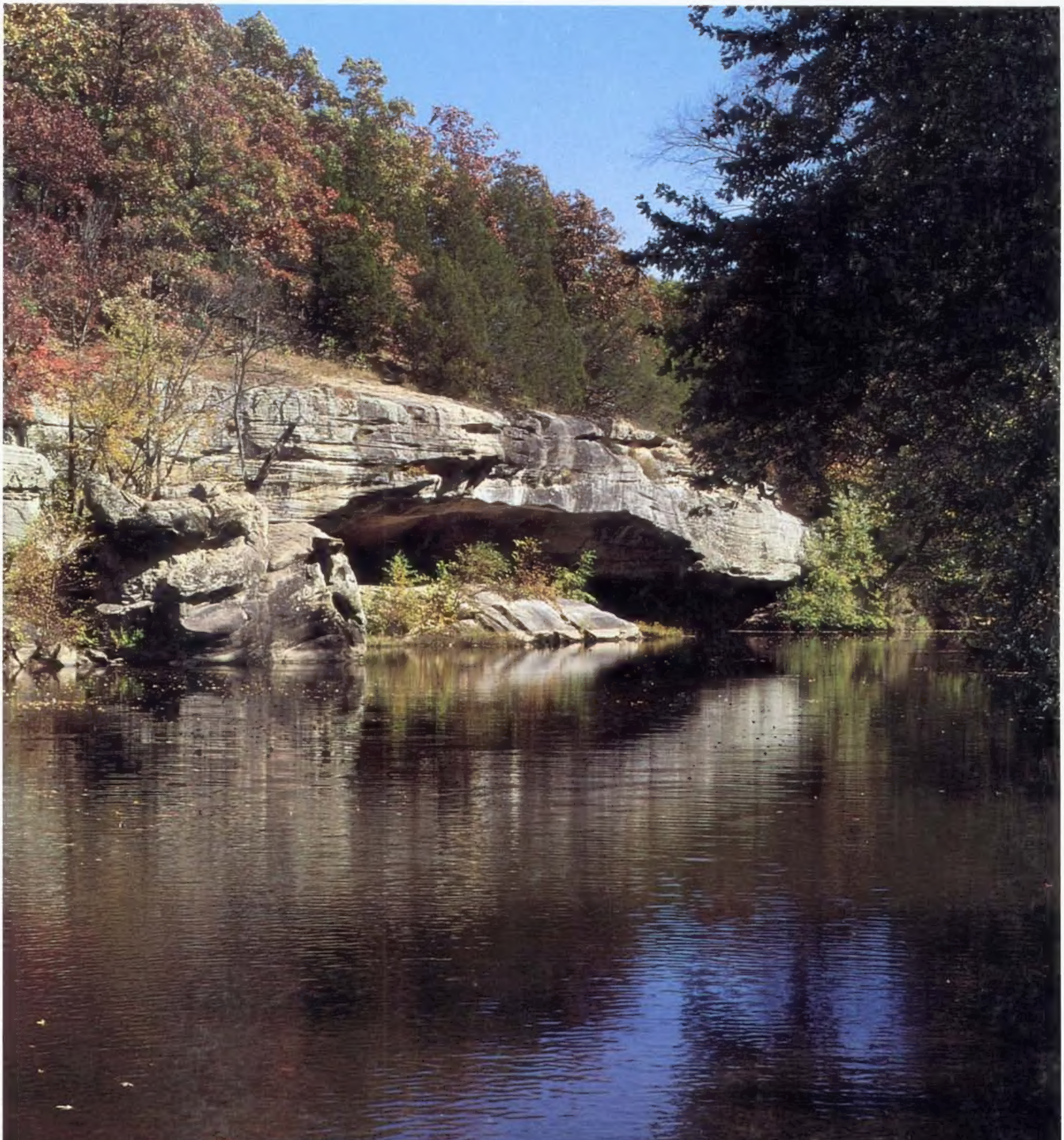
USDA United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with Missouri Agricultural Experiment Station

Soil Survey of Gasconade County, Missouri



How To Use This Soil Survey

General Soil Map

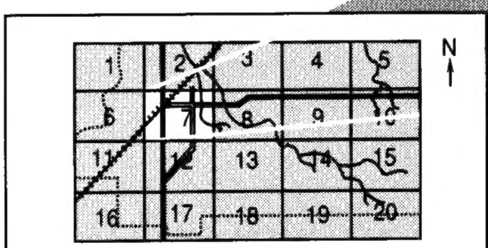
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

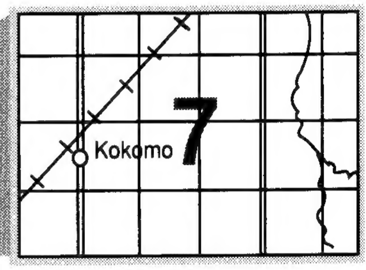
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.

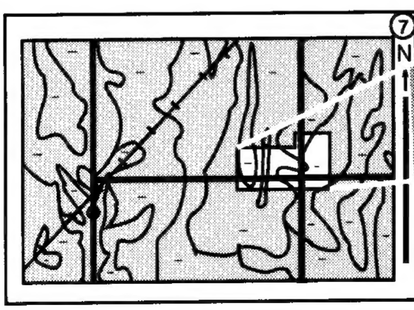


INDEX TO MAP SHEETS

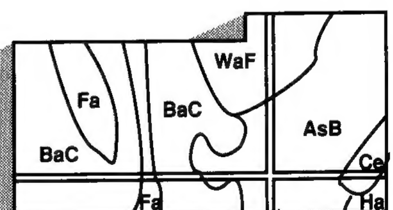


MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1990. Soil names and descriptions were approved in 1992. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1990. This survey was made cooperatively by the Natural Resources Conservation Service and the Missouri Agricultural Experiment Station. The Missouri Department of Natural Resources and the Gasconade County Soil and Water Conservation District provided soil scientists to assist with the fieldwork. The survey is part of the technical assistance furnished to the Gasconade County Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Natural Resources Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: Sandstone outcroppings of the Roubidoux Formation overlain by an area of the Coulstone-Union association. This formation has influenced the development of the soils in Gasconade County and enhances the scenic character of rivers and streams.

Contents

Issued November 1997

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Gasconade County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Roger A. Hansen
State Conservationist
Natural Resources Conservation Service

Soil Survey of Gasconade County, Missouri

By Robert J. Held and Keith O. Davis, Natural Resources Conservation Service

Fieldwork by Robert J. Held, Natural Resources Conservation Service; Wyn A. Kelley and F. Michael Struckhoff, Missouri Department of Natural Resources; and David L. Skaer, Gasconade County Soil and Water Conservation District

United States Department of Agriculture, Natural Resources Conservation Service,
in cooperation with
the Missouri Agricultural Experiment Station

GASCONADE COUNTY is in the east-central part of Missouri, on the northern edge of the Ozark region (fig. 1). The county has an area of 335,500 acres, or about 524 square miles.

The county is bordered on the north by the Missouri River, on the east by Franklin County, on the south by Crawford and Phelps Counties, and on the west by Maries and Osage Counties. The historic Missouri River town of Hermann, which is the county seat, had a population of 2,754 in 1991. The population of the entire county in 1991 was 14,006 (U.S. Department of Commerce, 1991).

Farming is the main enterprise in Gasconade County. Most farmers in the county raise beef cattle. Dairies and hog farming are of local importance. Light industry and tourism also contribute significantly to the economy of the county.

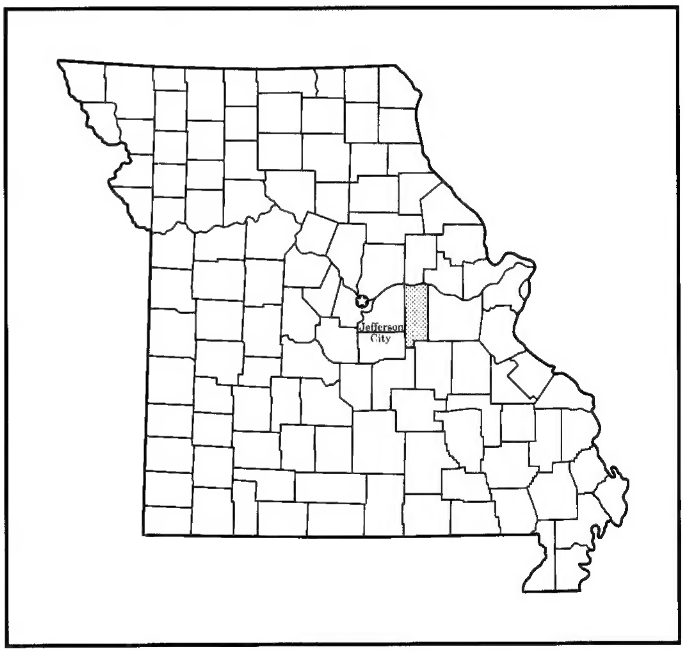


Figure 1.—Location of Gasconade County in Missouri.

General Nature of the County

This section provides general information about Gasconade County. It describes climate; water supply; physiography, relief, and drainage; and history and development.

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Freedom, Missouri, in the period 1962 to 1988. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 43 degrees F and the average daily minimum temperature is 33 degrees. The lowest temperature on record, which occurred at Freedom on January 22, 1985, is -10 degrees. In summer, the average temperature is 78 degrees and the average daily maximum temperature is 87 degrees. The highest recorded temperature, which occurred at Freedom on July 7, 1977, is 101 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 39 inches. Of this, nearly 24 inches, or about 60 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 17 inches. The heaviest 1-day rainfall during the period of record was 5.4 inches at Freedom on October 12, 1969. Thunderstorms occur on about 52 days each year.

The average seasonal snowfall is about 16 inches. The greatest snow depth at any one time during the period of record was 6 inches. On the average, 2 days of the year have at least 1 inch of snow on the ground.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 12 miles per hour, in spring.

Tornadoes and severe thunderstorms occur occasionally but are local and of short duration. Hailstorms occur at times during the warmer part of the year but in an irregular pattern and in only small areas.

Water Supply

Many of the upland soils in Gasconade County are suitable for the construction of ponds and small reservoirs. The water for most of the livestock in the county is supplied by these sources and from small creeks and scattered springs. Water for household use can also be obtained from these sources if they are properly located. The water should be tested and should be treated, if necessary. Most municipalities and rural residences obtain water from wells.

The quality of surface water and ground water is variable. This soil survey provides information that can improve or help to maintain the overall quality of the water supplies in the county.

The Missouri, Gasconade, and Bourbeuse Rivers are the largest streams in the county.

Physiography, Relief, and Drainage

Gasconade County has a diversity of landscape patterns. The Missouri River flood plain is in the extreme northwestern part of the county. The Gasconade River flows through the northwest quadrant of the county, and the flood plains along the Bourbeuse River and its larger tributaries are in the southernmost part. Highway 28 runs along the general drainage divide. Most tributaries north of this highway drain into the Gasconade River and subsequently into the Missouri River. South of the highway, drainage flows to the Bourbeuse River and subsequently into the Mississippi River.

The north-central part of the county is characterized by steep, dissected side slopes with sandstone cliffs. A broad, branching ridge system dominates the central part of the county, which is characterized by gently sloping to strongly sloping uplands. The rest of the county consists mainly of strongly sloping to steep uplands dissected by flood plains along small streams.

History and Development

The first permanent settlers arrived in the area in 1812 and made their living by hunting and by trading with the Indians (Gasconade County Historical Society, 1979). High-quality saltpeter was discovered in the area. It was used to preserve meats and for gunpowder (History of Southeast Missouri, 1888). German immigrants settled in the northern part of the county in 1837, after the purchase of 11,012 acres of land by the German Settlement Society of Philadelphia for a price of about $14,000. Many of the present communities still reflect a distinctly German influence.

Most of the early settlers lived on flood plains near watercourses. No attempt was made to settle the prairie region until about 1838 because of the lack of water and the difficulty involved in breaking out the stubborn prairie sod.

During the winter, some settlers kept livestock on the flood plains along the Missouri and Gasconade Rivers. These areas were covered with rushes and wild grasses.

Many settlers made a profitable business of rafting pine lumber from the upper Gasconade River to St. Louis. Others hauled iron from Crawford County to Hermann. Tanneries and grist mills were also important businesses.

Gasconade County was part of the Louisiana Purchase. It was organized by Congress in 1812. The

county was originally called the State of Gasconade and was a large territory that included all of 11 counties and parts of 12 others. As new counties were formed, the size of the original area was reduced. The present boundaries had been established by 1841. The town of Gasconade was the first county seat. It was also proposed as the capital of Missouri, but it missed this honor by two votes.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

The descriptions, names, and delineations of some of the soils on the maps of this survey do not fully agree with those on the maps of surveys of adjacent counties published at a different date. Differences are the result of additional soil data, variations in the intensity of mapping, and correlation decisions that reflect local conditions. In some areas, combining small acreages of

similar soils that respond to use and management in much the same way is more practical than mapping those soils separately and giving them different names.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Soil Descriptions

1. Beemont-Union Association

Very deep, gently sloping to steep, moderately well drained soils that formed in clayey residuum and loess; on uplands

This association is on major upland divides of the Owensville and Salem plateaus that extend into the county from the east, west, and south. Long, branching ridge systems with pasture and patches of hardwood forest separate rugged, dissected side slopes that are almost entirely forested. Narrow, branching flood plains converge in dendriform patterns to form tributaries to the Gasconade and Bourbeuse Rivers.

This association makes up about 46 percent of the county. It is about 47 percent Beemont and similar soils, 39 percent Union and similar soils, and 14 percent minor soils (fig. 2).

The very deep, moderately sloping to steep Beemont soils are on dissected side slopes.

The typical sequence, depth, and composition of the layers of the Beemont soils are as follows—

Surface layer:
0 to 2 inches, dark brown, very friable gravelly silt loam

Subsurface layer:
2 to 17 inches, light yellowish brown, friable gravelly silt loam and loam

Subsoil:
17 to 46 inches, strong brown and reddish yellow, firm clay

Substratum:
46 to 60 inches, strong brown, firm clay loam

The very deep, gently sloping to strongly sloping Union soils are on ridgetops and the convex upper side slopes with north and east aspects.

The typical sequence, depth, and composition of the layers of the Union soils are as follows—

Surface layer:
0 to 8 inches, brown, very friable silt loam

Subsoil:
8 to 28 inches, yellowish brown, strong brown, and dark yellowish brown, friable or firm silty clay loam or silty clay; mottled in the lower part
28 to 37 inches, a fragipan of dark yellowish brown, mottled, very firm and brittle silt loam
37 to 50 inches, a fragipan of mottled brown and light brownish gray, very firm and brittle extremely gravelly silt loam
50 to 60 inches, mottled brown and red, firm clay

Of minor extent in this association are the well drained Gladden soils on flood plains along small streams, the somewhat poorly drained Hartville and poorly drained Racoon soils on terraces, and the somewhat poorly drained Auxvasse soils on flood plains along high streams.

About 50 percent of the acreage in this association is forested. Large and small tracts support mixed stands of native hardwoods. Most areas of Union soils are used for pasture and hay or, to a lesser extent, for

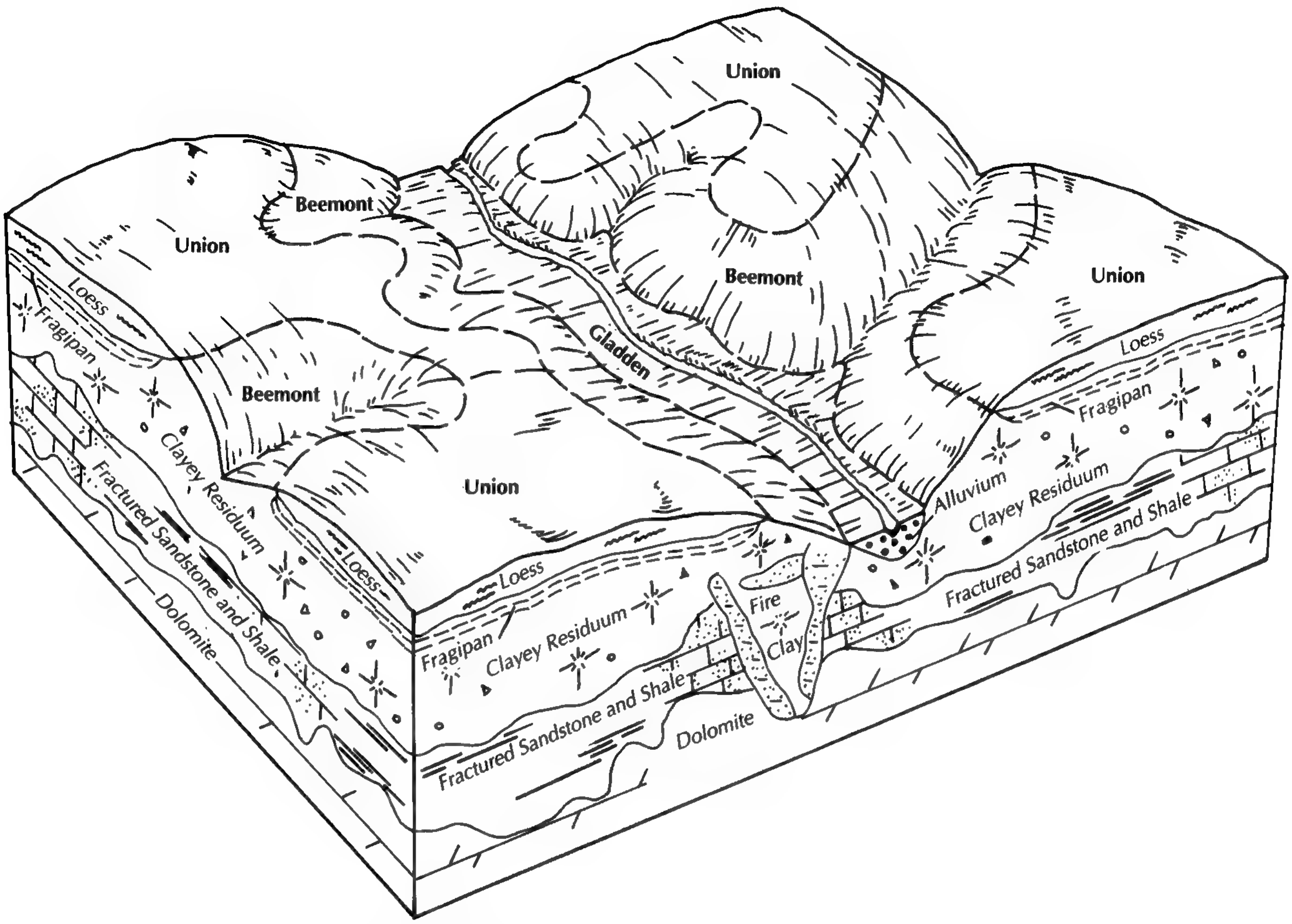


Figure 2.—Typical pattern of soils and parent material in the Beemont-Union association.

cultivated crops. Livestock production is the main enterprise in areas of this association. Small grain and grain sorghum are the major crops.

The soils in this association are suitable for trees. In areas of Beemont soils, stand composition varies significantly depending on the aspect of the slopes. Soils on north-facing slopes support mainly white oak and red oak. The stands on south-facing slopes are mainly black oak and post oak. The hazard of erosion, the equipment limitation, seedling mortality, and windthrow are management concerns.

In areas of the Union soils used for pasture, hay, or cultivated crops, the hazard of erosion and a low available water capacity are the main management concerns. Beemont soils are too gravelly and are generally too steep for these uses.

This association provides habitat for woodland wildlife, such as deer, turkeys, and squirrels, and for openland wildlife, such as rabbits and quail.

The major soils in this association are suitable for sewage lagoons and building site development. The main limitations are the shrink-swell potential, the slope, restricted permeability, and wetness.

2. Weingarten-Gatewood-Gasconade Association

Very deep to very shallow, moderately sloping to very steep, moderately well drained to somewhat excessively drained soils that formed in loess and clayey residuum over dolomite; on uplands

This association is in dissected upland areas bordering and downslope from remnants of the Owensville and Salem plateaus. Branching, loess-capped ridge systems with mixed pasture, hay, and cropland separate wooded side slopes dominated by dolomite bedrock at very shallow to moderate depths.

This association makes up about 22 percent of the county. It is about 39 percent Weingarten and similar

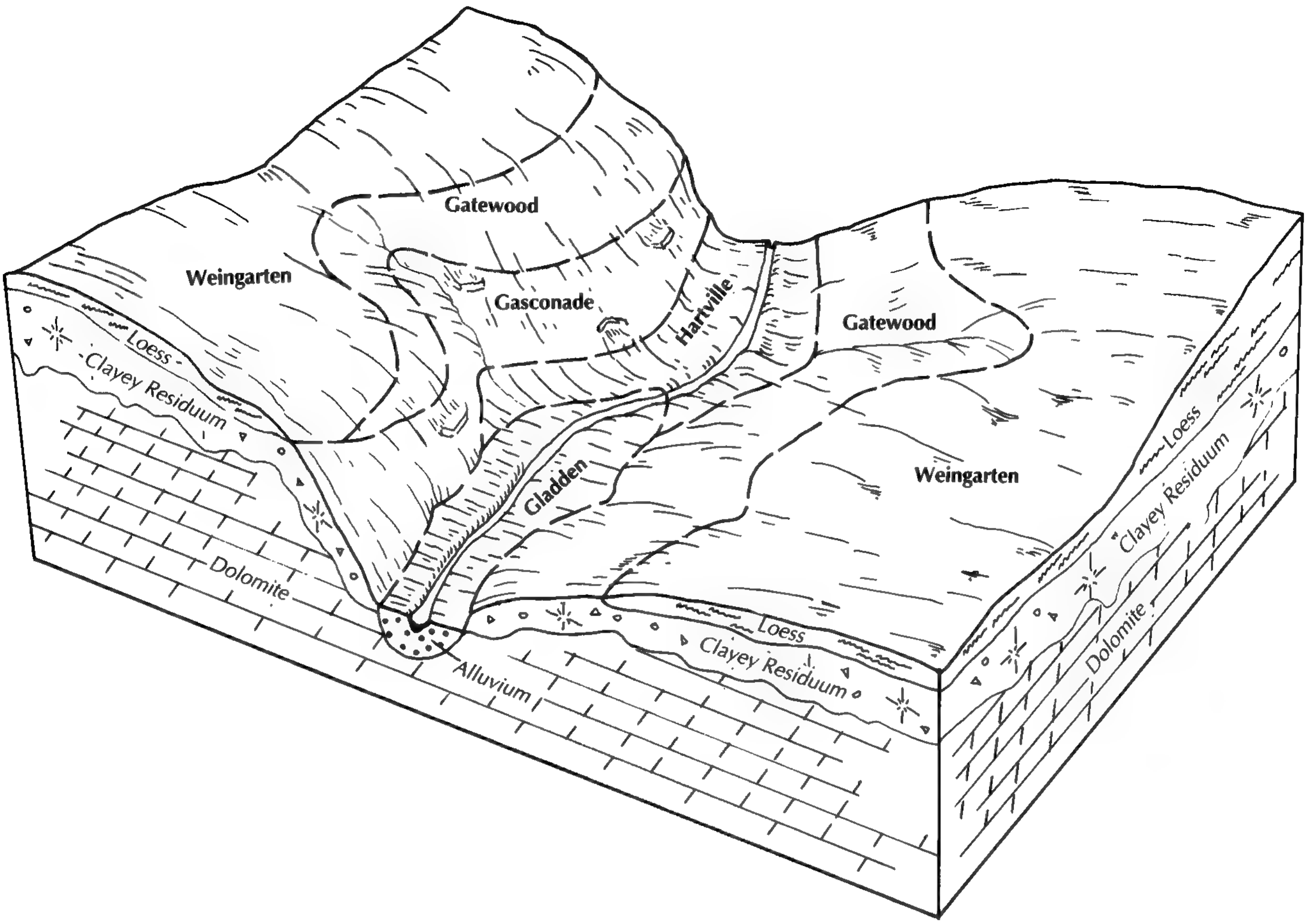


Figure 3.—Typical pattern of soils and parent material in the Weingarten-Gatewood-Gasconade association.

soils, 27 percent Gatewood and similar soils, 11 percent Gasconade and similar soils, and 23 percent minor soils (fig. 3).

The very deep, moderately well drained, moderately sloping to steep Weingarten soils are on narrow ridgetops and side slopes with north and east aspects.

The typical sequence, depth, and composition of the layers of the Weingarten soils are as follows—

Surface layer:

0 to 7 inches, dark brown, very friable silt loam

Subsoil:

7 to 18 inches, dark brown, friable silty clay loam

18 to 33 inches, yellowish brown and brown, mottled, firm silty clay loam

33 to 53 inches, dark yellowish brown, mottled, firm and brittle silt loam

53 to 65 inches, yellowish brown and red, mottled, firm and very firm gravelly silty clay loam and silty clay

The moderately deep, moderately well drained, moderately steep and steep Gatewood soils are on south- and west-facing side slopes.

The typical sequence, depth, and composition of the layers of the Gatewood soils are as follows—

Surface layer:

0 to 2 inches, very dark grayish brown, very friable gravelly silt loam

Subsurface layer:

2 to 10 inches, light yellowish brown, very friable gravelly silt loam

Subsoil:

10 to 30 inches, strong brown, mottled, very firm clay

Bedrock:

30 inches, dolomite

The very shallow and shallow, somewhat excessively

drained, moderately steep or steep Gasconade soils commonly are on the ends of ridges and on south- and west-facing side slopes.

The typical sequence, depth, and composition of the layers of the Gasconade soils are as follows—

Surface layer:
0 to 2 inches, very dark brown, friable gravelly clay loam

Subsoil:
2 to 10 inches, very dark grayish brown, firm very gravelly clay
10 to 18 inches, dark brown, very firm extremely gravelly clay

Bedrock:
18 inches, dolomite

Of minor extent in this association are the somewhat poorly drained Hartville soils on terraces, the well drained Gladden soils on flood plains along small streams, and the well drained Nolin soils on flood plains along the larger streams.

About 60 percent of this association is used for pasture, hay, or cultivated crops. Small grain and grain sorghum are the major crops. Livestock production is the main enterprise. The forested acreage consists of rough, steep areas that generally support mixed hardwoods. A significant acreage of Weingarten soils that was once cleared for pasture and hayland has reverted to redcedar and other second-growth tree stands.

The soils in this association are suitable for trees. The composition of forest stands is greatly influenced by soil type. In areas of Weingarten soils, white oak and red oak are the major species. Stands on Gatewood soils also include some black oak and post oak. Gasconade soils support mainly black oak, post oak, chinkapin oak, and redcedar. The hazard of erosion, the equipment limitation, seedling mortality, and windthrow are management concerns.

The hazard of erosion is the main concern affecting pasture, hayland, and cultivated crops on the Weingarten soils. Gatewood and Gasconade soils are too gravelly, too steep, and too close to areas of bedrock for these uses.

This association provides excellent habitat for woodland wildlife, such as deer, turkeys, and squirrels, and for openland wildlife, such as rabbits and quail.

Of the major soils in this association, only the Weingarten soils are suitable for sanitary facilities and building site development. The main limitations are the shrink-swell potential, the slope, and wetness. Gatewood and Gasconade soils are generally unsuitable for these uses because of the slope and the depth to bedrock.

3. Beemont-Weingarten Association

Very deep, moderately sloping to steep, moderately well drained soils that formed in clayey residuum and loess; on uplands

This association is in dissected upland areas in the north-central part of the county. Branching, loess-capped ridge systems with mixed pasture, hay, and cropland separate wooded side slopes.

This association makes up about 8 percent of the county. It is about 50 percent Beemont and similar soils, 30 percent Weingarten and similar soils, and 20 percent minor soils.

The very deep, moderately well drained, moderately sloping to steep Beemont soils are mostly on south- and west-facing side slopes.

The typical sequence, depth, and composition of the layers of the Beemont soils are as follows—

Surface layer:
0 to 2 inches, dark brown, very friable gravelly silt loam

Subsurface layer:
2 to 17 inches, light yellowish brown, friable gravelly silt loam and loam

Subsoil:
17 to 46 inches, strong brown and reddish yellow, firm clay

Substratum:
46 to 60 inches, strong brown, firm clay loam

The very deep, moderately well drained, moderately sloping to steep Weingarten soils are on narrow ridgetops and side slopes with north and east aspects.

The typical sequence, depth, and composition of the layers of the Weingarten soils are as follows—

Surface layer:
0 to 7 inches, dark brown, very friable silt loam

Subsoil:
7 to 18 inches, dark brown, friable silty clay loam
18 to 33 inches, yellowish brown and brown, mottled, firm silty clay loam
33 to 53 inches, dark yellowish brown, mottled, firm and brittle silt loam
53 to 65 inches, yellowish brown and red, mottled, firm and very firm gravelly silty clay loam and silty clay

Of minor extent in this association are the well drained Gladden soils on flood plains along small

streams and the somewhat excessively drained Ramsey soils on the steep upper side slopes.

About one-half of the acreage in this association is forested. Beemont soils are almost entirely forested, and scattered areas of Weingarten soils support mixed stands of native hardwoods. Some areas of Weingarten soils are used for pasture, hay, or cultivated crops, and livestock production is the main enterprise. Wheat is the principal small grain, and corn, soybeans, and grain sorghum are the chief row crops. Some areas of Weingarten soils that were once cleared for pasture and hayland have reverted to redcedar and other second-growth tree stands.

The soils in this association are suitable for trees. In areas of Beemont soils, stand composition varies significantly depending on the aspect of the slopes. Soils on north-facing slopes support mainly white oak and red oak. Stands on south-facing slopes are mainly black oak and post oak. The hazard of erosion, the equipment limitation, seedling mortality, and windthrow are management concerns.

The hazard of erosion is the main management concern affecting pasture, hayland, and cultivated crops in areas of the Weingarten soils. Beemont soils are too gravelly and too steep for these uses.

This association provides habitat for woodland wildlife, such as deer, turkeys, and squirrels, and for openland wildlife, such as rabbits and quail.

The major soils in this association are suitable for sanitary facilities and building site development. The main limitations are the shrink-swell potential, the slope, restricted permeability, and wetness.

4. Glensted Association

Very deep, nearly level and gently sloping, poorly drained soils that formed in loess and residuum; on uplands

This association occurs on the broad upland divides of the Owensville plateau. It consists of the highest portion of a very broad ridgetop that has virtually no incised drainage pattern and has long smooth slopes.

This association makes up about 2 percent of the survey area. It is about 86 percent Glensted soils and 14 percent minor soils.

The typical sequence, depth, and composition of the layers of the Glensted soils are as follows—

Surface layer:
0 to 8 inches, dark brown, very friable silt loam

Subsoil:
8 to 54 inches, dark grayish brown and grayish brown, mottled, firm silty clay, silty clay loam, and silt loam

Substratum:
54 to 60 inches, grayish brown, mottled, firm silty clay

Of minor extent in this association are the moderately well drained Union soils on narrow ridgetops and the upper side slopes and scattered areas of pits and quarries.

Small grain farming, pasture, and hay are the main land uses in areas of this association. Livestock production is the main enterprise. Wheat and grain sorghum are the major crops, but small acreages of corn and soybeans are also grown. Tall fescue is grown on a large acreage. Wetness and the hazard of erosion are the main concerns affecting pasture, hayland, and cultivated crops.

The major soils in this association are suitable for sanitary facilities and building site development. The main limitations are the shrink-swell potential, restricted permeability, and wetness.

5. Nolin-Racoon-Pope Association

Very deep, nearly level and very gently sloping, well drained and poorly drained soils that formed in alluvium; on flood plains

This association is on the flood plains along the Gasconade and Bourbeuse Rivers and along the major creeks in the county. Subtle changes in relief, characterized by differences in elevation of only a few feet, mark the landscape. Some areas have meandering stream channels or channel scars bordered by wet-site woodlands. Most areas are one-fourth to one-half mile in width. The soils formed in alluvium from Ozark highland areas.

This association makes up about 7 percent of the county. It is about 26 percent Nolin soils, 24 percent Racoon and similar soils, 12 percent Pope and similar soils, and 38 percent minor soils (fig. 4).

The well drained, nearly level, silty Nolin soils are on low flood plains.

The typical sequence, depth, and composition of the layers of the Nolin soils are as follows—

Surface layer:
0 to 9 inches, dark brown, very friable silt loam

Subsoil:
9 to 36 inches, dark brown, friable silt loam

Substratum:
36 to 60 inches, dark brown, friable silt loam

The poorly drained, nearly level and very gently sloping, silty Racoon soils are on low terraces.

The typical sequence, depth, and composition of the

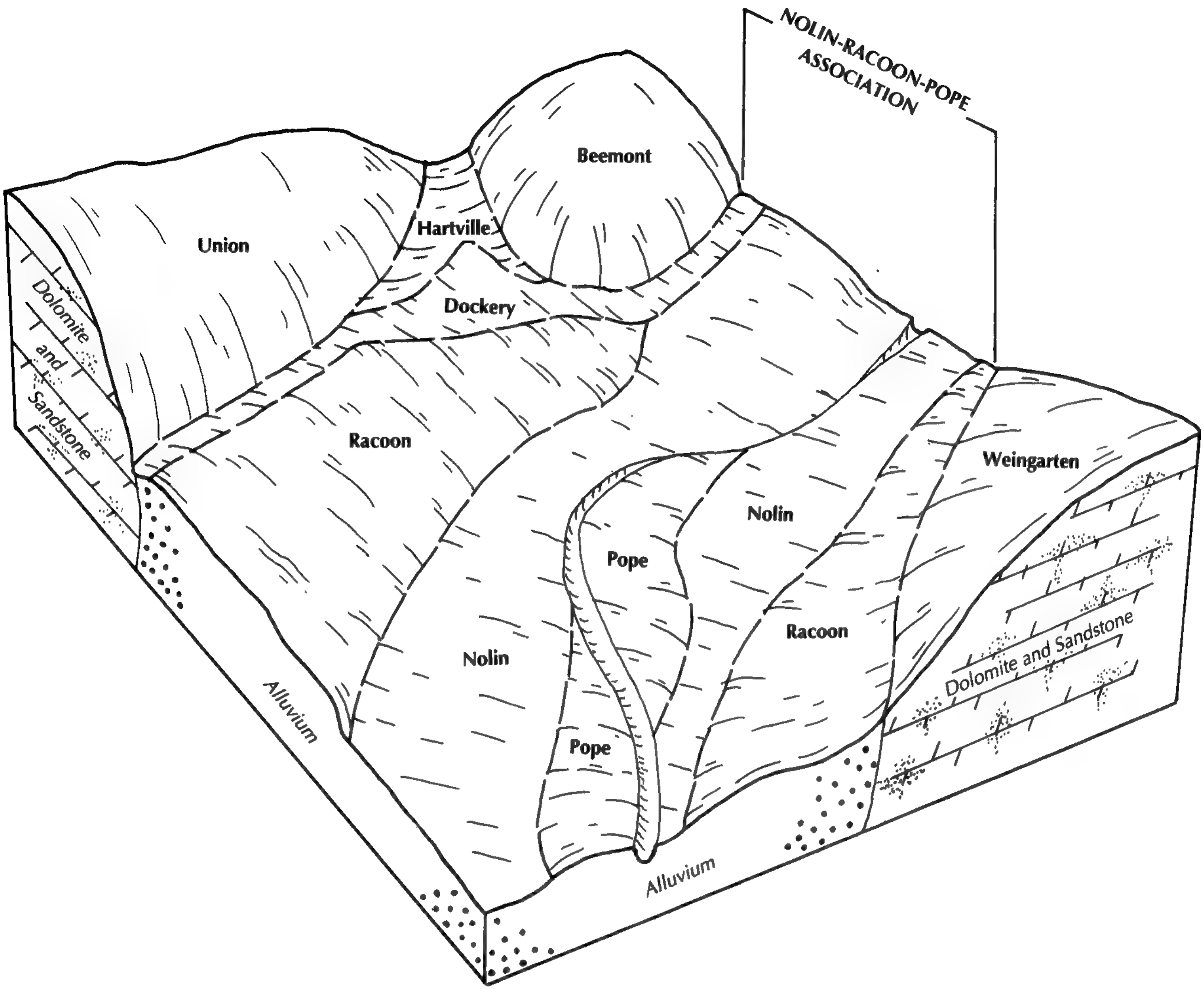


Figure 4.—Typical pattern of soils and parent material in the Nolin-Racoon-Pope association.

layers of the Racoon soils are as follows—

Surface layer:
0 to 9 inches, dark grayish brown, very friable silt loam

Subsurface layer:
9 to 27 inches, light gray and light brownish gray, mottled, friable and firm silt loam

Subsoil:
27 to 60 inches, grayish brown, mottled, firm silty clay loam

The well drained, nearly level, loamy Pope soils are mainly on high flood plains.

The typical sequence, depth, and composition of the layers of the Pope soils are as follows—

Surface layer:
0 to 10 inches, dark brown, very friable fine sandy loam

Subsoil:
10 to 34 inches, dark yellowish brown, mottled, very friable loam

Substratum:
34 to 60 inches, dark yellowish brown, very friable loam

Of minor extent in this association are the somewhat poorly drained Hartville soils on terraces, the somewhat poorly drained Dockery soils on flood plains, the

gravelly Cedargap soils along creek channels on flood plains, and the dark Bremer soils on high flood plains.

About 90 percent of this association is used for cultivated crops or for hay and pasture. Woodland areas are mostly in narrow strips adjacent to streams. Corn, soybeans, and wheat are the main crops.

The soils in this association are suitable for trees. The equipment limitation, seedling mortality, and windthrow are management concerns.

Flooding is a hazard affecting cultivated crops on all of the major soils in this association. Wetness is a limitation in areas of Racoon soils used for cultivated crops or for hay and pasture.

This association provides important habitat for both woodland and openland wildlife species. Grain left behind during harvest provides winter food for deer, turkeys, and squirrels. Little cover for woodland wildlife generally is available on the narrow flood plains, but cover is available on the adjacent uplands.

This association generally is unsuited to building site development and onsite waste disposal systems because of the flooding.

6. Waldron-Haynie Association

Very deep, nearly level, somewhat poorly drained and well drained soils that formed in alluvium; on flood plains

This association is on the flood plain along the Missouri River. Differences in the soils are largely a result of differences in texture of the materials in which the soils formed. Differences in elevation are slight, but they have an important effect on the distribution of soils on the flood plain. Sandy materials predominate in the higher areas near the present channel. Clayey alluvium is in swales adjacent to the uplands, and loamy material is between the uplands and the swales.

This association makes up about 1 percent of the county. It is about 45 percent Waldron soils, 35 percent Haynie soils, and 20 percent minor soils.

The somewhat poorly drained, clayey Waldron soils are in depressions on the flood plain.

The typical sequence, depth, and composition of the layers of the Waldron soils are as follows—

Surface layer:

0 to 9 inches, very dark grayish brown, firm silty clay

Substratum:

9 to 55 inches, stratified dark grayish brown, very dark grayish brown, and brown, mottled, firm silty clay and silty clay loam

55 to 60 inches, stratified very dark grayish brown and brown, friable silt loam and very fine sandy loam

The well drained, loamy Haynie soils are in elevated areas on the flood plain.

The typical sequence, depth, and composition of the layers of the Haynie soils are as follows—

Surface layer:

0 to 9 inches, very dark grayish brown, very friable very fine sandy loam

Substratum:

9 to 36 inches, stratified yellowish brown and brown, mottled, very friable very fine sandy loam

36 to 60 inches, stratified brown and yellowish brown, mottled, very friable silt loam

Of minor extent in this association are the excessively drained Sarpy soils on flood plains. These soils are mainly on the river side of the levee on natural levees adjacent to the channel.

The soils in this association are intensively cultivated. An earthen levee is installed between the river and most of the flood plain. Corn, soybeans, and wheat are the main crops. Flooding is a hazard affecting cultivated crops on all of the major soils, and wetness is a limitation in areas of Waldron soils used for cultivated crops or for hay and pasture.

The soils in this association are suitable for trees. Areas that are not protected by a levee are forested in many places. The equipment limitation and seedling mortality are management concerns.

This association provides important habitat for both woodland and openland wildlife species. Grain left behind during harvest provides winter food for deer, turkeys, and squirrels. The cropped areas provide little cover for woodland wildlife, but cover is available in the adjacent uplands and in wooded areas near the main river channel.

This association generally is unsuitable for building site development and onsite waste disposal systems because of the flooding.

7. Menfro-Gatewood Association

Very deep and moderately deep, gently sloping to steep, well drained and moderately well drained soils that formed in loess or clayey residuum over dolomite; on uplands

This association is on the "River Hills," which is a band 1 to 3 miles wide adjacent to the flood plain along the Missouri River. The association is characterized by branching, loess-capped ridge systems and some side slopes. Deep soils on north- and east-facing slopes support mixed pasture, hay, and cropland. Soils in steep areas on south- and west-facing slopes mainly have dolomite bedrock at a moderate depth. Nearly all

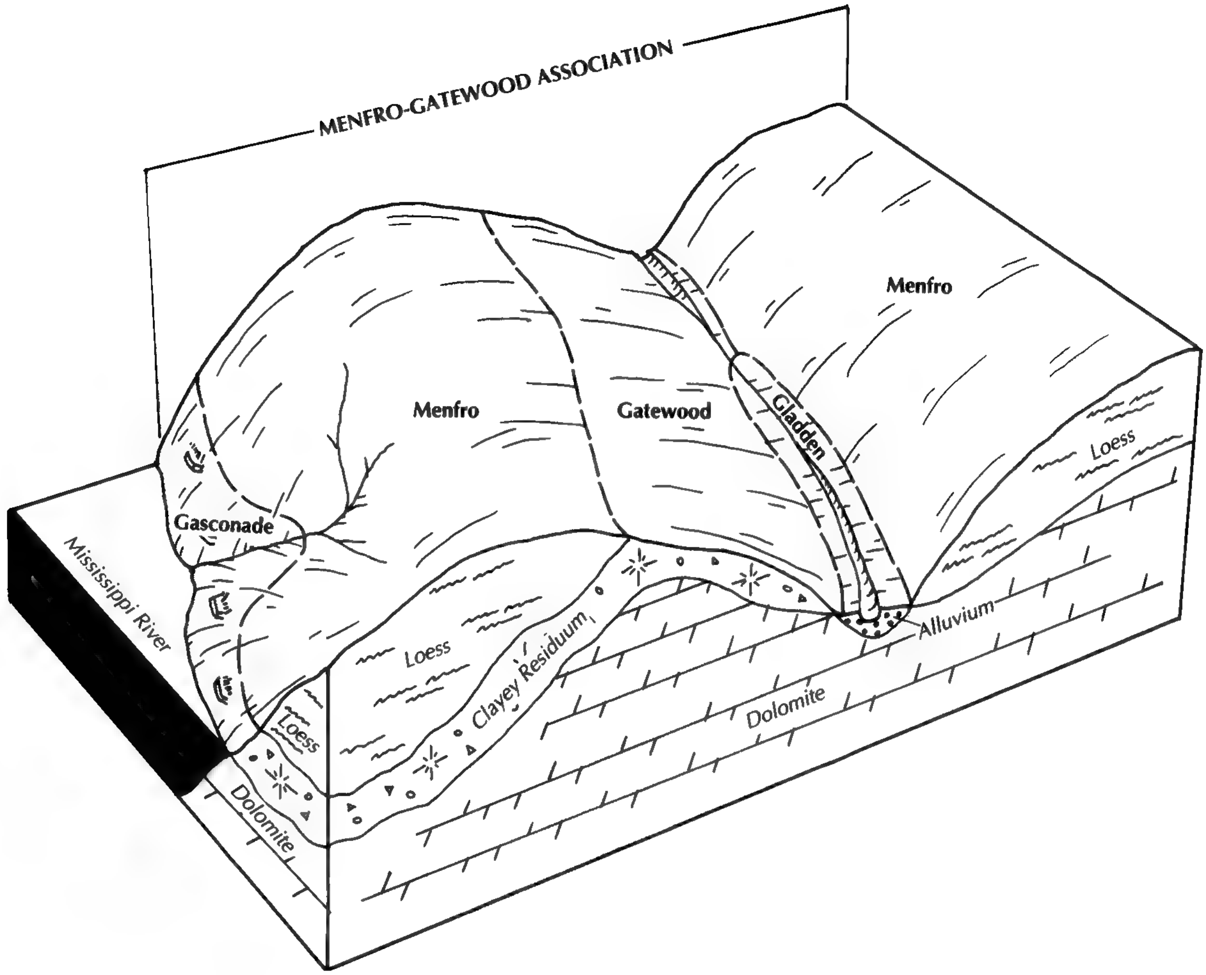


Figure 5.—Typical pattern of soils and parent material in the Menfro-Gatewood association.

of these areas are wooded. Some of the slopes end at cliffs overlooking the river channel or flood plain.

This association makes up about 7 percent of the county. It is about 54 percent Menfro and similar soils, 27 percent Gatewood and similar soils, and 19 percent minor soils (fig. 5).

The very deep, well drained, gently sloping to steep Menfro soils are on ridgetops, side slopes, and foot slopes.

The typical sequence, depth, and composition of the layers of the Menfro soils are as follows—

Surface layer:

0 to 7 inches, dark brown, very friable silt loam

Subsoil:

7 to 12 inches, dark yellowish brown, friable silt loam

12 to 62 inches, dark brown, friable and firm silty clay loam

The moderately deep, moderately well drained, moderately steep and steep Gatewood soils are on the lower south- and west-facing side slopes.

The typical sequence, depth, and composition of the layers of the Gatewood soils are as follows—

Surface layer:

0 to 2 inches, very dark grayish brown, very friable gravelly silt loam

Subsurface layer:

2 to 10 inches, light yellowish brown, very friable gravelly silt loam

Subsoil:

10 to 30 inches, strong brown, mottled, firm and very firm clay

Bedrock:

30 inches, dolomite

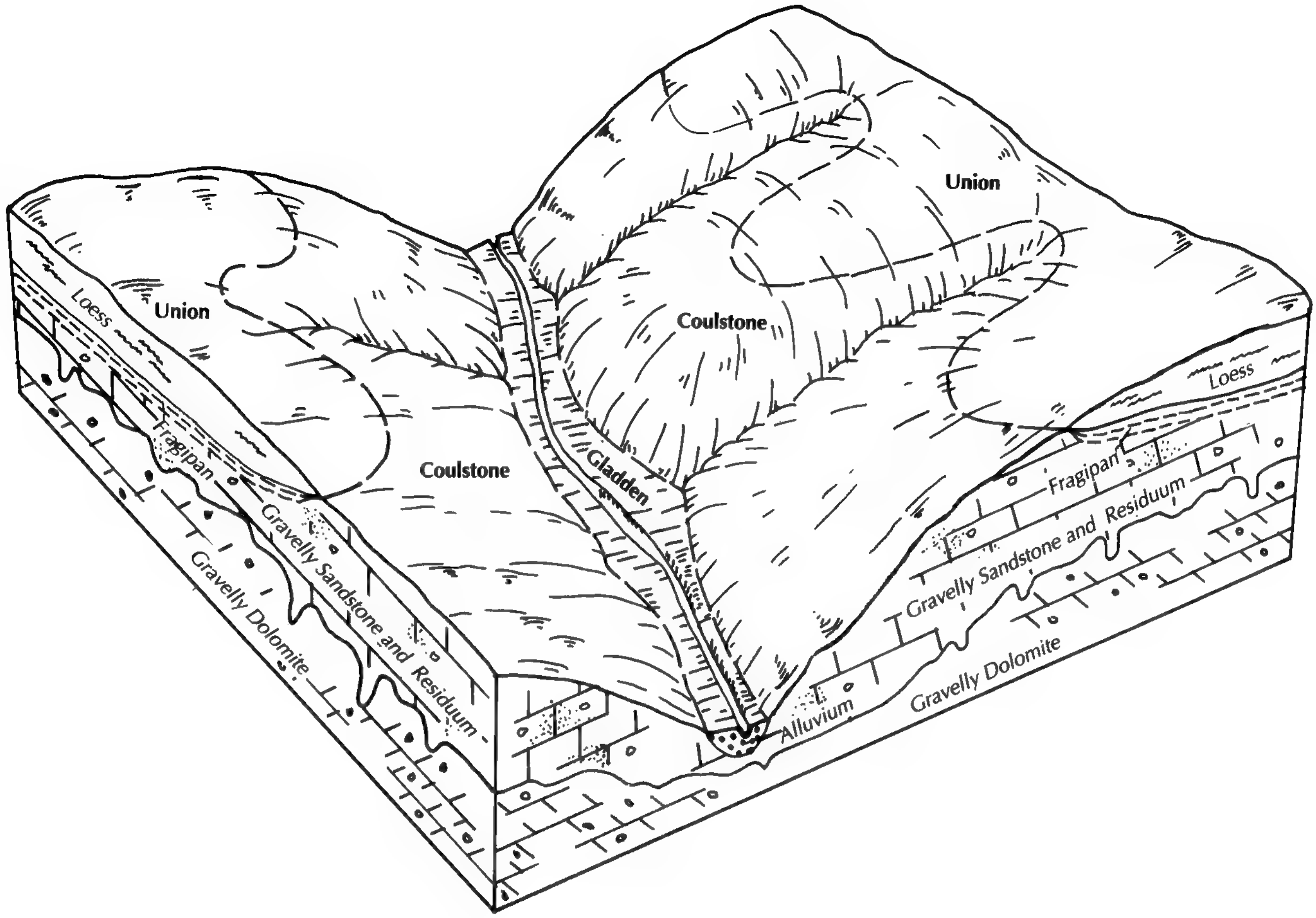


Figure 6.—Typical pattern of soils and parent material in the Coulstone-Union association.

Of minor extent in this association are the very shallow and shallow Gasconade soils on the lower south-facing side slopes, the loamy Gladden soils on flood plains along small streams, and the deep Bucklick soils on the upper south-facing side slopes.

About 60 percent of this association is used for hay, pasture, or cultivated crops. Corn, soybeans, and small grain are the main cultivated crops. Livestock production is the main enterprise. The forested acreage generally consists of rough, steep areas that support mixed hardwoods. A significant acreage of Menfro soils that was once cleared for pasture and hayland has reverted to redcedar and other second-growth tree stands.

The hazard of erosion is the main concern affecting pasture, hayland, and cultivated crops in areas of the Menfro soils. Gatewood soils are too gravelly, too steep, and too close to areas of bedrock for these uses.

The soils in this association are suitable for trees. The composition of forest stands is greatly influenced by soil type. In areas of Menfro soils, white oak and red oak are the major species. Stands on Gatewood soils also include black oak and post oak. The hazard of erosion and the equipment limitation are management concerns.

This association provides excellent habitat for woodland wildlife, such as deer, turkeys, and squirrels, and for openland wildlife, such as rabbits and quail.

Of the major soils in this association, only the Menfro soils are suitable for sanitary facilities and building site development. The main limitations are the shrink-swell potential and the slope. Gatewood soils are generally unsuitable for these uses because of the slope and the depth to bedrock.

8. Coulstone-Union Association

Very deep, gently sloping to very steep, moderately well drained and somewhat excessively drained soils that

formed in loess and residuum; on uplands

This association is on uplands that are highly dissected by narrow incised drainageways. It is in areas where the oldest rock formations in the county have been exposed to weathering and stream dissection along the flanks of the Ozark uplift. Narrow, branching flood plains converge in dendriform patterns to form tributaries to the Gasconade and Bourbeuse Rivers.

This association makes up about 7 percent of the county. It is about 43 percent Coulstone soils, 36 percent Union soils, and 21 percent minor soils (fig. 6).

The somewhat excessively drained, moderately steep and steep Coulstone soils are on side slopes.

The typical sequence, depth, and composition of the layers of the Coulstone soils are as follows—

Surface layer:

0 to 3 inches, very dark grayish brown, very friable gravelly fine sandy loam

Subsurface layer:

3 to 16 inches, light yellowish brown and yellowish brown, friable and very friable gravelly sandy loam and extremely gravelly sandy loam

16 to 30 inches, yellowish brown, friable extremely gravelly sandy loam

Subsoil:

30 to 60 inches, strong brown and yellowish red, friable very gravelly sandy loam and very gravelly clay loam

The moderately well drained, gently sloping to strongly sloping Union soils are on ridgetops and the upper side slopes.

The typical sequence, depth, and composition of the layers of the Union soils are as follows—

Surface layer:

0 to 8 inches, brown, very friable silt loam

Subsoil:

8 to 28 inches, yellowish brown, strong brown, and dark yellowish brown, friable and firm silty clay loam and silty clay; mottled in the lower part

28 to 37 inches, a fragipan of dark yellowish brown, very firm and brittle silt loam

37 to 50 inches, a fragipan of mottled brown and light brownish gray, very firm and brittle extremely gravelly silt loam

50 to 60 inches, mottled brown and red, firm clay

Of minor extent in this association are the loamy-skeletal Wilderness soils on the upper side slopes and the well drained Gladden and Cedargap soils on narrow flood plains. Wilderness soils have a fragipan.

About 70 percent of this association is forested. Many areas of Union soils are used for pasture, hay, or wildlife habitat. A few areas on the broadest ridgetops are used for cultivated crops. Some areas of minor soils on the larger flood plains also are used for cultivated crops. Livestock production is the main enterprise in areas of this association.

The soils in this association are suitable for trees. White oak and red oak are the major species in wooded areas. The hazard of erosion, the equipment limitation, and seedling mortality are management concerns.

The hazard of erosion and a low available water capacity are the main concerns affecting pasture, hayland, and cultivated crops on the Union soils. Coulstone soils are too gravelly and are generally too steep for these uses.

This association provides habitat for woodland wildlife, such as deer, turkeys, and squirrels.

The major soils in this association are suitable for sanitary facilities and building site development. The main limitations are the shrink-swell potential, the slope, restricted permeability, and wetness.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under the heading "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Union silt loam, 5 to 9 percent slopes, is a phase of the Union series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Beemont-Ramsey-Rock outcrop complex, 14 to 35 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, quarries, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

01B—Union silt loam, 2 to 5 percent slopes. This very deep, gently sloping, moderately well drained soil is on broad ridgetops in the uplands. Individual areas are long and branched and range from about 20 to 200 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:

0 to 6 inches, dark brown, very friable silt loam

Subsurface layer:

6 to 9 inches, dark yellowish brown, very friable silt loam

Subsoil:

9 to 19 inches, dark yellowish brown, firm silty clay

19 to 28 inches, dark yellowish brown, firm silty clay loam

28 to 35 inches, a fragipan of yellowish brown, mottled, very firm and brittle silt loam

35 to 46 inches, a fragipan of yellowish brown, mottled, very firm and brittle very gravelly silt loam

46 to 56 inches, strong brown, mottled, firm silty clay
56 to 60 inches, strong brown and red, firm clay

In some eroded areas the plow layer is brown silty clay loam.

Included with this soil in mapping are some areas of the somewhat poorly drained Marion soils. These soils are in the middle of some broad ridges. They make up about 5 percent of the map unit.

Important properties of the Union soil—

Permeability: Moderate above the fragipan, slow in the fragipan
Surface runoff: Medium
Available water capacity: Low
Organic matter content: Moderately low
Seasonal high water table: Perched at a depth of 1.5 to 3.0 feet
Shrink-swell potential: Moderate

Most areas are used for hay and pasture. A limited acreage is used for row crops. Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Pasture and hay species that are drought resistant should be selected for planting. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the moderate depth to the fragipan. This soil is moderately well suited to big bluestem, indiangrass, lespedeza, orchardgrass, reed canarygrass, and tall fescue. It is moderately suited to switchgrass, ladino clover, and red clover. When new seedings are being established, tilling on the contour, growing nurse crops, or leaving crop residue on the surface helps to control erosion.

This soil is suited to corn, soybeans, small grain, and grasses and legumes in proper crop rotations. Insufficient soil moisture is a problem affecting summer crops because of the restricted rooting depth. Early planting of short-season varieties helps to minimize damage to corn. Grain sorghum and winter wheat are inherently drought resistant. If the soil is used for cultivated crops, erosion is a hazard. Using a combination of conservation practices helps to prevent excessive soil loss. A system of conservation tillage that leaves a protective cover of residue mulch on the surface helps to control erosion. Many areas are too narrow to be managed independently but can be included with adjacent soils for management with terrace systems and contour farming. Contour stripcropping involves alternating permanent strips of grasses or legumes with row crops planted on the contour. The grass-legume strips minimize erosion and help to filter the sediments from runoff that would otherwise leave the field. Such systems are extremely effective, inexpensive, and flexible. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

This soil is suited to trees. Only slight limitations affect planting or harvesting.

This soil is suitable for building site development and onsite waste disposal systems if proper design and installation procedures are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Excavation may be difficult because of the fragipan. Properly constructed sewage lagoons function adequately on this soil. Wetness and the slope are limitations. Grading the area helps to modify the slope, and sealing the bottom of the lagoon helps to overcome the wetness.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling, by wetness, and by frost action.

The land capability classification is IIe. The woodland ordination symbol is 3D.

01C—Union silt loam, 5 to 9 percent slopes. This very deep, moderately sloping, moderately well drained soil is on rounded ridgetops in the uplands. Individual areas are long and branched and range from about 5 to several hundred acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 8 inches, brown, very friable silt loam

Subsoil:
8 to 11 inches, yellowish brown, friable silty clay loam
11 to 17 inches, strong brown, firm silty clay loam
17 to 28 inches, dark yellowish brown, mottled, firm silty clay
28 to 37 inches, a fragipan of dark yellowish brown, very firm and brittle silt loam
37 to 50 inches, a fragipan of mottled brown and light brownish gray, very firm and brittle extremely gravelly silt loam
50 to 60 inches, mottled brown and red, firm clay

In some eroded areas the surface layer is silty clay loam. In places the subsoil is clay loam. The central part of some ridgetops is gently sloping. In some areas the fragipan is weakly expressed.

Included with this soil in mapping are small areas of gravelly Beemont soils on the lower slopes. Also included are the somewhat poorly drained Marion soils in nearly level areas. Included soils make up about 10 percent of the map unit.

Important properties of the Union soil—

Permeability: Moderate above the fragipan, slow in and below the fragipan
Surface runoff: Medium
Available water capacity: Low
Organic matter content: Moderately low
Seasonal high water table: Perched at a depth of 1.5 to 3.0 feet
Shrink-swell potential: Moderate

Most areas are used for hay and pasture. A limited acreage is used for row crops. Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Pasture and hay species that are drought resistant should be selected for planting. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the moderate depth to the fragipan. This soil is moderately well suited to big bluestem, indiangrass, lespedeza, orchardgrass, reed canarygrass, and tall fescue. It is moderately suited to switchgrass, ladino clover, and red clover. When new seedings are being established, tilling on the contour, planting nurse crops, or leaving crop residue on the surface helps to control erosion.

This soil is suited to corn, soybeans, small grain, and grasses and legumes in proper crop rotations. Insufficient soil moisture is a problem affecting summer crops because of the restricted rooting depth. Early planting of short-season varieties helps to minimize damage to corn. Grain sorghum and winter wheat are inherently more stress tolerant than some other crops. If the soil is used for cultivated crops, erosion is a hazard. Using a combination of conservation practices helps to prevent excessive soil loss. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Many areas are smoothly sloping and large enough to be terraced and farmed on the contour. Cuts made during the construction of terraces may expose the fragipan, resulting in droughty areas that may be gravelly in places. Covering the exposed channel with topsoil from adjacent areas helps to prevent exposing the fragipan. Contour stripcropping involves alternating permanent strips of grasses or legumes with row crops planted on the contour. The grass-legume strips minimize erosion and help to filter the sediments from runoff that would otherwise leave the field. Such systems are extremely effective, inexpensive, and flexible. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

A significant acreage of native hardwood forest remains in areas of this soil. Most of this woodland could benefit from selective cutting and stand improvement. Some areas that were once cleared and cultivated are reverting to forest. Only slight limitations affect planting or harvesting.

This soil is suitable for building site development and onsite waste disposal systems if proper design and installation procedures are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Excavation may be difficult because of the fragipan. Properly constructed sewage lagoons function adequately on this soil. The slope and the wetness are limitations. Grading the area helps to modify the slope, and sealing the bottom of the lagoon helps to overcome the wetness.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling, by wetness, and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3D.

01C2—Union silt loam, 5 to 9 percent slopes, eroded. This very deep, moderately sloping, moderately well drained soil is on side slopes in the uplands. Much of the original surface soil has eroded away. The remaining surface soil has been mixed with the upper part of the subsoil by tillage. In areas that are not protected by a plant cover, rills and small gullies form after rains of moderate intensity. Individual areas of this soil are irregular in shape and range from about 10 to more than 200 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 7 inches, brown, friable silt loam

Subsoil:

7 to 13 inches, brown, firm silty clay loam
13 to 21 inches, brown, firm silty clay
21 to 31 inches, a fragipan of yellowish brown, very firm and brittle silty clay loam
31 to 39 inches, a fragipan of light yellowish brown, very firm and brittle very gravelly silty clay loam
39 to 60 inches, strong brown and yellowish red, firm clay

In some uneroded areas the surface layer is more than 7 inches thick. In places the subsoil is clay loam. In many areas the surface layer is silty clay loam. In some places the fragipan is weakly expressed.

Included with this soil in mapping are small areas of gravelly Beemont soils on the lower slopes. These soils make up about 5 percent of the map unit.

Important properties of the Union soil—

Permeability: Moderate above the fragipan, slow in and below the fragipan
Surface runoff: Medium
Available water capacity: Low
Organic matter content: Low
Seasonal high water table: Perched at a depth of 1.5 to 3.0 feet
Shrink-swell potential: Moderate

Most areas are used for hay and pasture. A limited acreage is used for row crops. Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Pasture and hay species that are drought resistant should be selected for planting. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the moderate depth to the fragipan. This soil is moderately well suited to big bluestem, indiangrass, lespedeza, orchardgrass, reed canarygrass, and tall fescue. It is moderately suited to switchgrass, ladino clover, and red clover. When new seedings are being established, tilling on the contour, planting nurse crops, or leaving crop residue on the surface helps to prevent excessive erosion.

This soil is suited to corn, soybeans, small grain, and grasses and legumes in proper crop rotations. Insufficient soil moisture is a problem affecting summer crops because of the restricted rooting depth. Early planting of short-season varieties helps to minimize damage to corn. Grain sorghum and winter wheat are inherently more stress tolerant than some other crops. The hazard of further erosion is severe if the soil is used for cultivated crops. Using a combination of conservation practices helps to prevent excessive soil loss. A system of conservation tillage that leaves a protective cover of crop residue on the surface after planting helps to control erosion. Many areas have smooth slopes and are large enough to be terraced and farmed on the contour. Cuts made during the construction of terraces may expose the fragipan, resulting in droughty areas that may be gravelly in places. Covering the exposed channel with topsoil from adjacent areas helps to prevent exposing the fragipan. Contour stripcropping involves alternating permanent strips of grasses or legumes with row crops planted on the contour. The grass-legume strips minimize erosion and help to filter the sediments from runoff that would otherwise leave the field. Such systems are extremely effective, inexpensive, and flexible. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

A significant acreage of native hardwood forest remains in areas of this soil. Most of this woodland could benefit from selective cutting and stand improvement. Some areas that were once cleared and cultivated are reverting to forest. Only slight limitations affect planting or harvesting.

This soil is suitable for building site development and onsite waste disposal systems if proper design and installation procedures are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Excavation may be difficult because of the fragipan. Properly constructed sewage lagoons function adequately on this soil. The slope and the wetness are limitations. Grading the area helps to modify the slope, and sealing the bottom of the lagoon helps to overcome the wetness.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling, by wetness, and by frost action.

The land capability classification is IVe. The woodland ordination symbol is 3D.

01D2—Union silt loam, 9 to 14 percent slopes, eroded. This very deep, strongly sloping, moderately well drained soil is on north- and east-facing side slopes and narrow ridgetops in the uplands. Much of the original surface soil has eroded away. In areas that are not protected by a plant cover, rills and small gullies form after rains of moderate intensity. Individual areas

of this soil are irregular in shape and range from about 6 to more than 40 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:

0 to 5 inches, dark brown, very friable silt loam

Subsoil:

5 to 12 inches, strong brown, firm silty clay loam

12 to 21 inches, dark yellowish brown, very firm silty clay

21 to 28 inches, yellowish brown, mottled, very firm silty clay loam

28 to 34 inches, a fragipan of yellowish brown and light brownish gray, mottled, very firm and brittle silt loam

34 to 44 inches, a fragipan of brown and light brownish gray, mottled, very firm and brittle silt loam

44 to 60 inches, dark brown and reddish gray, mottled, very firm very gravelly silty clay

In some areas the surface layer is silty clay loam. In places the fragipan is weakly expressed. In many areas the surface layer is more than 7 inches thick.

Included with this soil in mapping are some small areas of gravelly Beemont soils. These soils are generally on the lower slopes along drainageways. They make up about 5 percent of the map unit.

Important properties of the Union soil—

Permeability: Moderate above the fragipan, slow in and below the fragipan
Surface runoff: Rapid
Available water capacity: Low
Organic matter content: Low
Seasonal high water table: Perched at a depth of 1.5 to 3.0 feet
Shrink-swell potential: Moderate

Most areas are used for hay, pasture, or woodland. A very small acreage is used for cultivated crops. This soil is suited to hay, pasture, and woodland. It is generally not used for cultivated crops because of a severe hazard of erosion and because of droughtiness, which is caused by the fragipan.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Pasture and hay species that are drought resistant should be selected for planting. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the moderate depth to the fragipan. This soil is moderately well suited to indiangrass, big bluestem, tall fescue, reed canarygrass, lespedeza, and birdsfoot trefoil. It is moderately suited to switchgrass and orchardgrass. When new seedings are being established, tilling on the contour, planting nurse crops, or leaving crop residue on the surface helps to control erosion.

A significant acreage of native hardwood forest remains on this soil. Most of this woodland could benefit from selective cutting and stand improvement. Some areas that were once cleared and cultivated are reverting to forest. Only slight limitations affect planting or harvesting.

This soil is suitable for building site development and onsite waste disposal systems if proper design and installation procedures are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Excavation may be difficult because of the fragipan. Properly constructed sewage lagoons function adequately on this soil. The slope and the wetness are limitations. Grading the area helps to modify the slope, and sealing the bottom of the lagoon helps to overcome the wetness. Also, the sewage can be piped to adjacent areas that are more suitable for lagoons.

Low strength, the shrink-swell potential, the slope, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Some cut and fill may be necessary because of the slope, or the roads can be designed so that they conform to the natural contour of the landscape. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling, by wetness, and by frost action.

The land capability classification is VIe. The woodland ordination symbol is 3D.

02F—Coulstone gravelly fine sandy loam, 14 to 35 percent slopes. This very deep, moderately steep and steep, somewhat excessively drained soil is on side slopes in the uplands. Most areas are long and irregularly shaped and range from about 10 to several hundred acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:

0 to 3 inches, very dark grayish brown, very friable gravelly fine sandy loam

Subsurface layer:

3 to 16 inches, light yellowish brown, very friable very gravelly fine sandy loam

16 to 30 inches, yellowish brown, friable extremely gravelly sandy loam

Subsoil:

30 to 37 inches, strong brown, friable very gravelly sandy loam

37 to 60 inches, yellowish red, friable very gravelly loam

In most of the less sloping areas on north- and east-facing slopes, the surface layer is silt loam. In some places bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of Ramsey soils. These soils are shallow over sandstone bedrock. Also included, in the steeper areas, are the moderately deep Gatewood and very shallow or shallow Gasconade soils. Included soils make up about 15 percent of the map unit.

Important properties of the Coulstone soil—

Permeability: Moderately rapid
Surface runoff: Very rapid
Available water capacity: Low
Organic matter content: Moderately low
Shrink-swell potential: Moderate

Most areas support native forest, but some areas have been cleared and are used for pasture. This soil is best suited to trees. The equipment limitation and seedling mortality are management concerns. Equipment should be used only when the soil is dry or frozen. Using track type equipment or yarding the logs uphill to logging roads or skid trails may be necessary. Because of the slope and chert fragments throughout the surface layer, it may be necessary to plant seedlings by hand or direct seeding. Planting container-grown nursery stock improves the seedling survival rate. The seedling mortality rate is generally much higher on south- and west-facing slopes than in other areas. Reinforcement planting or replanting may be needed.

This soil is unsuited to cultivated crops and hayland. It can be used for pasture, but the hazard of erosion, droughtiness, and chert fragments in the surface layer are management concerns. Grasses and legumes that are drought resistant should be selected for planting because of the limited available water capacity. The soil is moderately suited to big bluestem, indiangrass, switchgrass, crownvetch, lespedeza, and tall fescue. It is poorly suited to orchardgrass and timothy. When new seedings are being established, broadcast seeding may be necessary because of the slope and the chert fragments. Planting nurse crops helps to prevent excessive erosion until the intended forage crop is established. Carefully maintaining the height and vigor of the forage plants helps to prevent the formation of rills and gullies.

This soil is suitable for building site development and for onsite waste disposal systems if proper design and installation procedures are used. Land shaping can modify the slope, or the dwellings can be designed so that they conform to the natural contour of the landscape. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. The design of septic tank absorption fields should compensate for the slope, or the sewage can be piped to adjacent areas that are more suitable for lagoons or septic tank absorption fields.

The slope, the shrink-swell potential, and the potential for frost action are limitations on sites for local roads and streets. Some cut and fill may be necessary because of the slope, or the roads can be designed so that they conform to the natural contour of the landscape. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is VIIe. The woodland ordination symbol is 3R.

03A—Racoon silt loam, 0 to 3 percent slopes, rarely flooded. This very deep, nearly level and very gently sloping, poorly drained soil is on low terraces. It is subject to brief periods of flooding. Most areas are irregular in shape and range from about 5 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:

0 to 9 inches, dark grayish brown, very friable silt loam

Subsurface layer:

9 to 20 inches, light gray, mottled, friable silt loam

20 to 27 inches, light brownish gray, mottled, friable silt loam

Subsoil:

27 to 60 inches, grayish brown, mottled, firm silty clay loam

In some areas the subsurface layer is compact and brittle.

Included with this soil in mapping are some small areas of the somewhat poorly drained Auxvasse soils. These soils are in slightly elevated areas. They make up about 10 percent of the map unit.

Important properties of the Racoon soil—

Permeability: Slow
Surface runoff: Slow
Available water capacity: High
Organic matter content: Moderately low
Seasonal high water table: At the surface to 1 foot below the surface
Shrink-swell potential: High

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for pasture and hay. Wetness and the flooding are the main limitations affecting cultivated crops. The wetness is caused by hillside runoff and poor surface drainage. Diversions can protect the soil from excess runoff from the adjacent uplands. Surface drainage can be improved by land grading or surface ditches. Levees or flood-control structures minimize flood damage and crop losses. In many areas a compacted subsurface layer restricts the movement of air and water. As a result, moisture may be inadequate in summer and wetness can be a problem in early spring. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

The flooding and the wetness are concerns if this soil is used for hay or pasture. Pasture and hay species that tolerate wetness should be selected for planting. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the high water table. This soil is moderately suited to alsike clover and reed canarygrass. It is poorly suited or generally unsuited to most warm-season grasses, legumes, and cool-season grasses. Diversions can protect the soil from excess runoff from the adjacent uplands. Land grading or surface ditches help to remove excess water. Grazing should be restricted to periods when flooding is not likely.

This soil is suited to trees. A few small areas support native forest. Wetness-tolerant species should be selected for planting. The equipment limitation, seedling mortality, and windthrow are management concerns. Equipment should be used only when the soil is dry or frozen. Planting container-grown nursery stock and ridging the soil before planting improve the seedling survival rate. Thinning the stands lightly and frequently minimizes windthrow damage.

This soil is unsuitable for building site development because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 4W.

04A—Freeburg silt loam, 0 to 3 percent slopes, rarely flooded. This very deep, nearly level and very gently sloping, somewhat poorly drained soil is on high flood plains. Most areas are irregular in shape and range from about 10 to more than 80 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 11 inches, dark brown, very friable silt loam

Subsurface layer:
11 to 19 inches, brown and yellowish brown, mottled, friable silt loam

Subsoil:
19 to 24 inches, brown, mottled, firm silty clay loam
24 to 41 inches, brown and yellowish brown, mottled, firm silty clay loam
41 to 60 inches, yellowish brown, mottled, firm silty clay loam

In some places the surface layer is loam.

Included with this soil in mapping are small areas of the poorly drained Racoon soils in the less sloping areas and in depressions. Also included are some gently sloping or moderately sloping soils around the perimeter of the mapped areas. Included areas make up about 10 percent of the map unit.

Important properties of the Freeburg soil—

Permeability: Moderately slow
Surface runoff: Slow
Available water capacity: High
Organic matter content: Moderately low
Seasonal high water table: Perched at a depth of 1.5 to 3.0 feet
Shrink-swell potential: Moderate

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for pasture and hay. Wetness and the flooding are the main limitations affecting cultivated crops. The wetness is caused primarily by hillside runoff. Diversions can protect the soil from excess runoff from the adjacent uplands. Levees or flood-control structures minimize flood damage and crop losses. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Wetness is a concern if this soil is used for hay or pasture. Pasture and hay species that tolerate wetness should be selected for planting. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the high water table. This soil is well suited to reed canarygrass. It is moderately well suited to switchgrass, ladino clover, red clover, tall fescue, and timothy. It is moderately suited to big bluestem, indiangrass, and alfalfa. Diversions can protect the soil from excess runoff from the adjacent uplands. Grazing should be restricted to periods when flooding is not likely.

This soil is suited to trees. Only slight limitations affect planting or harvesting.

This soil is unsuitable for building site development because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 3A.

05B—Hartville silt loam, 2 to 5 percent slopes. This very deep, gently sloping, somewhat poorly drained soil is on terraces. Individual areas are elongated and range from about 10 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 9 inches, dark brown, very friable silt loam

Subsoil:
9 to 13 inches, dark yellowish brown, mottled, friable silt loam
13 to 20 inches, brown, mottled, firm silty clay loam
20 to 42 inches, brown, mottled, firm silty clay
42 to 60 inches, grayish brown, mottled, firm silty clay

In places the surface layer is silty clay loam. In some areas the subsoil is silty clay loam throughout. In other areas the surface layer has gravelly textures resulting from downslope movement from adjacent soils that formed in residuum.

Included with this soil in mapping are small areas of the nearly level Auxvasse soils and areas of soils that have a cherty surface layer. The cherty soils are in areas adjacent to the uplands. Also included, on the lower slopes, are some poorly drained soils that have gray colors in the subsoil. Included soils make up about 10 percent of the map unit.

Important properties of the Hartville soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: Moderate
Organic matter content: Moderately low
Seasonal high water table: Perched at a depth of 1.5 to 3.0 feet
Shrink-swell potential: High

Most areas are used for row crops, hay, or pasture. This soil is suited to corn, soybeans, small grain, and grasses and legumes in proper crop rotations. If the soil is used for cultivated crops, erosion is a hazard. Using a combination of conservation practices helps to prevent excessive soil loss. A system of conservation tillage that leaves crop residue on the surface after planting helps to control erosion. Many areas have smooth slopes and are large enough to be terraced and farmed on the contour. Cuts made during the construction of terraces can expose the clayey subsoil, which cannot be easily tilled, is low in fertility and available water, and may require special management practices. Covering the exposed channel with topsoil from adjacent areas helps to prevent exposing the subsoil. Contour stripcropping involves alternating permanent strips of grasses or legumes with row crops planted on the contour. The grass-legume strips minimize erosion and help to filter the sediments from runoff that would otherwise leave the field. Such systems are extremely effective, inexpensive, and flexible. Diversions can protect the soil from excess runoff from the adjacent uplands. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Pasture and hay species that tolerate wetness should be selected for planting. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the water table. This soil is well suited to ladino clover. It is moderately well suited to big bluestem, indiangrass, switchgrass, alsike clover, tall fescue, and timothy. It is moderately suited to red clover and orchardgrass. Diversions can protect the soil from excess runoff from the adjacent uplands. When new seedings are being established, tilling on the contour, planting nurse crops, or leaving crop residue on the surface helps to prevent excessive erosion.

This soil is suited to trees. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock improves the seedling survival rate. The seedling mortality rate is generally much higher on south- and west-facing slopes than in other areas. Reinforcement planting or replanting may be needed. Thinning the stands lightly and frequently minimizes windthrow damage.

This soil is suitable for building site development and onsite waste disposal systems if proper design and installation practices are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Diversions can help to protect the site from runoff from adjacent uplands. Properly constructed sewage lagoons function adequately on this soil. Grading the area helps to overcome the slope.

The shrink-swell potential, low strength, the potential for frost action, and the wetness are limitations on sites

for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling, by wetness, and by frost action.

The land capability classification is IIe. The woodland ordination symbol is 3C.

05C—Hartville silt loam, 5 to 9 percent slopes. This very deep, moderately sloping, somewhat poorly drained soil is on terraces. Individual areas are elongated and range from about 10 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:

0 to 9 inches, dark brown, very friable silt loam

Subsoil:

9 to 12 inches, brown, mottled, firm silty clay loam
12 to 21 inches, yellowish brown, mottled, firm silty clay
21 to 35 inches, grayish brown, mottled, firm silty clay loam
35 to 41 inches, yellowish brown and grayish brown, mottled, firm silty clay loam
41 to 48 inches, mottled yellowish brown, grayish brown, and gray, firm silty clay loam
48 to 60 inches, mottled yellowish brown, grayish brown, and gray, firm silty clay

In some eroded areas the surface layer is silty clay loam. In places the surface layer and the subsoil have gravelly textures as a result of downslope movement from adjacent soils that formed in residuum.

Included with this soil in mapping are areas of the well drained Bucklick and moderately well drained Weingarten soils in the upper areas and in stable interfluves. Also included are poorly drained soils at the base of the mapped areas or in areas where water concentrates. Included soils make up about 10 percent of the map unit.

Important properties of the Hartville soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: Moderate
Organic matter content: Moderately low
Seasonal high water table: Perched at a depth of 1.5 to 3.0 feet
Shrink-swell potential: High

Most areas are used for hay, pasture, or row crops. This soil is suited to corn, soybeans, small grain, and grasses and legumes in proper crop rotations. The hazard of further erosion is severe if the soil is used for cultivated crops. Using a combination of conservation practices helps to prevent excessive soil loss. A system of conservation tillage that leaves crop residue on the surface after planting helps to control erosion. Many areas have smooth slopes and are large enough to be terraced and farmed on the contour. Cuts made during the construction of terraces can expose the clayey subsoil, which cannot be easily tilled, is low in fertility and available water, and may require special management practices. Covering the exposed channel with topsoil from adjacent areas helps to prevent exposing the subsoil. Contour stripcropping involves alternating permanent strips of grasses or legumes with row crops planted on the contour. The grass-legume strips minimize erosion and help to filter the sediments from runoff that would otherwise leave the field. Such systems are extremely effective, inexpensive, and flexible. Diversions can protect the soil from excess runoff from the adjacent uplands. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Pasture and hay species that tolerate wetness should be selected for planting. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the high water table. This soil is well suited to ladino clover. It is moderately well suited to big bluestem, indiangrass, switchgrass, alsike clover, tall fescue, and timothy. It is moderately suited to red clover and orchardgrass. Diversions can protect the soil from excess runoff from the adjacent uplands. When new seedings are being established, tilling on the contour, planting nurse crops, or leaving crop residue on the surface helps to prevent excessive erosion.

This soil is suited to trees. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock improves the seedling survival rate. The seedling mortality rate is generally much higher on south- and west-facing slopes than in other areas. Reinforcement planting or replanting may be needed. Thinning the stands lightly and frequently minimizes windthrow damage.

This soil is suitable for building site development and onsite waste disposal systems if proper design and installation practices are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Installing drainage tile around the footings helps to prevent the

damage caused by excessive wetness. Properly constructed sewage lagoons function adequately on this soil. Grading the area helps to overcome the slope.

The shrink-swell potential, low strength, the potential for frost action, and the wetness are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling, by wetness, and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3C.

06C2—Bucklick silt loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, well drained soil is on ridgetops and side slopes in the uplands. Much of the original surface soil has eroded away. In areas that are not protected by a plant cover, rills and small gullies form after rains of moderate intensity. Individual areas of this soil are long and narrow and range from about 6 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:

0 to 6 inches, dark brown, very friable silt loam

Subsoil:

6 to 15 inches, yellowish red, firm silty clay loam
15 to 22 inches, brown, firm silty clay
22 to 43 inches, brown and yellowish red, mottled, firm silty clay
43 to 52 inches, yellowish red, mottled, firm gravelly silty clay

Bedrock:

52 inches, dolomite

In places the surface layer is more than 7 inches thick. In some areas bedrock is at a depth of more than 60 inches. In other areas the surface layer is silty clay loam.

Included with this soil in mapping are some areas of the moderately deep Gatewood soils and the very shallow and shallow Gasconade soils. These soils are primarily in the lower positions on the landscape and are on south- and west-facing slopes. They make up about 10 percent of the map unit.

Important properties of the Bucklick soil—

Permeability: Moderate
Surface runoff: Medium
Available water capacity: Moderate
Organic matter content: Moderate
Shrink-swell potential: High

Most areas are used for hay and pasture. A limited acreage is used for row crops. This soil is suited to corn, soybeans, small grain, and grasses and legumes in proper crop rotations. If the soil is used for cultivated crops, erosion is a hazard. Using a combination of conservation practices helps to prevent excessive soil loss. A system of conservation tillage that leaves crop residue on the surface after planting helps to control erosion. Many areas have smooth slopes and are large enough to be terraced and farmed on the contour. Cuts made during the construction of terraces may expose cherty material, resulting in droughty areas that may be gravelly in places. Covering the exposed channel with topsoil from adjacent areas helps to prevent exposing the cherty material. Contour stripcropping involves alternating permanent strips of grasses or legumes with row crops planted on the contour. The grass-legume strips minimize erosion and help to filter the sediments from runoff that would otherwise leave the field. Such systems are extremely effective, inexpensive, and flexible. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. This soil is well suited to big bluestem, indiangrass, switchgrass, and most other warm-season grasses; to alfalfa, ladino clover, red clover, and most other legumes; and to orchardgrass, tall fescue, timothy, and most other cool-season grasses. When new seedings are being established, tilling on the contour, planting nurse crops, or leaving crop residue on the surface helps to prevent excessive erosion.

This soil is suited to trees. A considerable acreage supports native forest. Many of the wooded areas could benefit from selective cutting and stand improvement. Only slight limitations affect planting or harvesting.

This soil is suitable for building site development and onsite waste disposal systems if proper design and installation procedures are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. The design of dwellings with basements should compensate for the limited depth to bedrock. Blasting may be needed to remove the bedrock. Septic tank absorption fields function adequately if the thickness of the soil material above the bedrock is increased sufficiently for adequate filtration. Lengthening the lateral lines helps to overcome the restricted permeability. The slope and wetness are limitations on sites for sewage lagoons. Grading the area helps to

modify the slope. Sealing the bottom of the lagoon helps to overcome the wetness and helps to prevent the contamination of ground water. Also, the sewage can be piped to adjacent areas that are more suitable for sewage lagoons.

Low strength, the shrink-swell potential, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

06D2—Bucklick silt loam, 9 to 14 percent slopes, eroded. This deep, strongly sloping, well drained soil is on smooth, convex side slopes in the uplands. Much of the original surface soil has eroded away. In areas that are not protected by a plant cover, rills and small gullies form after rains of moderate intensity. Individual areas of this soil are irregular in shape and range from about 10 to more than 80 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 7 inches, dark brown, friable silt loam

Subsoil:
7 to 17 inches, brown, mottled, firm silty clay
17 to 36 inches, brown and reddish brown, mottled, firm silty clay
36 to 48 inches, reddish brown, mottled, firm silty clay loam
48 to 54 inches, brown, mottled, firm very gravelly silty clay

Bedrock:
54 inches, dolomite

In some places the surface layer is silty clay loam. In some places the depth to bedrock is more than 60 inches. In some uneroded areas the surface layer is more than 7 inches thick.

Included with this soil in mapping are some small areas of the moderately deep Gatewood soils and the very shallow and shallow Gasconade soils. These soils are generally on south-facing slopes. They make up about 5 percent of the map unit.

Important properties of the Bucklick soil—

Permeability: Moderate
Surface runoff: Rapid
Available water capacity: Moderate
Organic matter content: Moderate
Shrink-swell potential: High

Most areas are used for hay, pasture, or woodland. This soil is suited to hay and pasture. It is suited to row crops on a limited basis. The hazard of further erosion is severe if the soil is used for cultivated crops. Using a combination of conservation practices helps to prevent excessive soil loss. A system of conservation tillage that leaves crop residue on the surface after planting helps to control erosion. Many areas have smooth slopes and are large enough to be terraced and farmed on the contour. Terraces reduce the steepness of the slope. Narrow-base terraces or terraces that have grassed back slopes may be more desirable than conventional terraces if the soil is used for row crops. Cuts made during the construction of terraces may expose cherty material, resulting in droughty areas that may be gravelly in places. Covering the exposed channel with topsoil from adjacent areas helps to prevent exposing the cherty material. Contour stripcropping involves alternating permanent strips of grasses or legumes with row crops planted on the contour. The grass-legume strips minimize erosion and help to filter the sediments from runoff that would otherwise leave the field. Such systems are extremely effective, inexpensive, and flexible. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. This soil is well suited to switchgrass, ladino clover, red clover, tall fescue, and timothy. It is moderately well suited to big bluestem, indiangrass, alfalfa, and orchardgrass. When new seedings are being established, tilling on the contour, planting nurse crops, or leaving crop residue on the surface helps to prevent excessive erosion.

This soil is suited to trees. A considerable acreage supports native forest. Most of the wooded areas could benefit from selective cutting and stand improvement. A significant acreage of abandoned farmland is reverting to forest. Only slight limitations affect planting or harvesting of trees.

This soil is suitable for building site development and onsite waste disposal systems if proper design and installation procedures are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. The design of dwellings with basements should compensate for the limited depth to bedrock. Blasting may be needed to remove the bedrock. Land shaping

can modify the slope, or the dwellings can be designed so that they conform to the natural contour of the land. Septic tank absorption fields function adequately if the thickness of the soil material above the bedrock is increased sufficiently for adequate filtration. Lengthening the lateral lines helps to overcome the restricted permeability, and the lines should be established across the slope. The slope and wetness are limitations on sites for sewage lagoons. Grading the area helps to modify the slope. Sealing the bottom of the lagoon helps to overcome the wetness and helps to prevent the contamination of ground water. Also, the sewage can be piped to adjacent areas that are more suitable for lagoons.

Low strength, the shrink-swell potential, the slope, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Some cut and fill may be necessary because of the slope, or the roads can be designed so that they conform to the natural contour of the landscape. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IVe. The woodland ordination symbol is 3A.

07B—Menfro silt loam, 2 to 5 percent slopes. This very deep, gently sloping, well drained soil is on broad ridges and foot slopes in the uplands. Individual areas are long and branching and range from about 10 to more than 30 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 7 inches, dark brown, very friable silt loam

Subsurface layer:
7 to 15 inches, brown, very friable silt loam

Subsoil:
15 to 20 inches, dark brown, friable silt loam
20 to 55 inches, dark brown, firm silty clay loam

Substratum:
55 to 62 inches, dark brown, firm silt loam

In a few eroded areas, material from the subsoil has been mixed into the plow layer.

Included with this soil in mapping are some small areas of Bucklick soils that have bedrock at a depth of 40 to 60 inches. These soils are primarily on the lower south- and west-facing slopes. They make up about 10 percent of the map unit.

Important properties of the Menfro soil—

Permeability: Moderate
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderately low
Shrink-swell potential: Moderate

Most areas are used for row crops, hay, or pasture. This soil is suited to corn, soybeans, small grain, and grasses and legumes in proper crop rotations. If the soil is used for cultivated crops, erosion is a hazard. Using a combination of conservation practices helps to prevent excessive soil loss. A system of conservation tillage that leaves crop residue on the surface after planting helps to control erosion. Most areas are too narrow to be managed independently but can be included with adjacent soils for management with terrace systems and contour farming. Contour stripcropping involves alternating permanent strips of grasses or legumes with row crops planted on the contour. The grass-legume strips minimize erosion and help to filter the sediments from runoff that would otherwise leave the field. Such systems are extremely effective, inexpensive, and flexible. In areas on foot slopes, diversions help to control surface runoff from adjacent uplands. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. This soil is well suited to big bluestem, indiangrass, switchgrass, and most other warm-season grasses; to alfalfa, ladino clover, red clover, and most other legumes; and to orchardgrass, tall fescue, timothy, and most other cool-season grasses. When new seedings are being established, tilling on the contour, planting nurse crops, or leaving crop residue on the surface helps to prevent excessive erosion.

This soil is suited to trees. Only slight limitations affect planting or harvesting.

This soil is suitable for building site development and onsite waste disposal systems if proper design and installation procedures are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Septic tank absorption fields generally function adequately.

Low strength, the shrink-swell potential, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Constructing roadside ditches

and installing culverts for drainage can minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIe. The woodland ordination symbol is 3A.

07C—Menfro silt loam, 5 to 9 percent slopes. This very deep, moderately sloping, well drained soil is on ridgetops in the uplands. Individual areas are long and branching and range from about 20 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 7 inches, dark brown, very friable silt loam

Subsoil:
7 to 12 inches, dark yellowish brown, friable silt loam
12 to 60 inches, dark brown, firm silty clay loam

In some eroded areas the surface layer is less than 7 inches thick. In some places the surface layer is silty clay loam. In other places the soil is strongly sloping.

Included with this soil in mapping are some small areas of Bucklick soils that have bedrock at a depth of 40 to 60 inches. These soils are mostly at the head of drainageways. They make up about 10 percent of the map unit.

Important properties of the Menfro soil—

Permeability: Moderate
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderately low
Shrink-swell potential: Moderate

Most areas are used for row crops, hay, or pasture. This soil is suited to corn, soybeans, small grain, and grasses and legumes in proper crop rotations. If the soil is used for cultivated crops, erosion is a hazard. Using a combination of conservation practices helps to prevent excessive soil loss. A system of conservation tillage that leaves crop residue on the surface after planting helps to control erosion. Many areas have smooth slopes and are large enough to be terraced and farmed on the contour. Contour stripcropping involves alternating permanent strips of grasses or legumes with row crops planted on the contour. The grass-legume strips minimize erosion and help to filter the sediments from runoff that would otherwise leave the field. Such systems are extremely effective, inexpensive, and flexible. In areas on foot slopes, diversions help to control surface runoff from adjacent uplands. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. This soil is well suited to big bluestem, indiangrass, switchgrass, and most other warm-season grasses; to alfalfa, ladino clover, red clover, and most other legumes; and to orchardgrass, tall fescue, timothy, and most other cool-season grasses. When new seedings are being established, tilling on the contour, planting nurse crops, or leaving crop residue on the surface helps to prevent excessive erosion.

This soil is suited to trees. Only slight limitations affect planting or harvesting.

This soil is suitable for building site development and onsite waste disposal systems if proper design and installation procedures are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Septic tank absorption fields generally function adequately.

Low strength, the shrink-swell potential, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

07E2—Menfro silt loam, 14 to 20 percent slopes, eroded. This very deep, moderately steep, well drained soil is on side slopes. Much of the original surface soil has eroded away. The remaining surface soil has been mixed with the upper part of the subsoil by tillage. In areas that are not protected by a plant cover, rills and small gullies form after rains of moderate intensity. Individual areas of this soil are irregular in shape and range from about 20 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 9 inches, brown, very friable silt loam

Subsoil:
9 to 24 inches, dark brown, friable silt loam
24 to 33 inches, mottled dark brown and dark yellowish brown, firm silty clay loam
33 to 42 inches, dark yellowish brown, mottled, firm silty clay loam

42 to 51 inches, brown and dark yellowish brown, mottled, firm silty clay loam

Substratum:

51 to 66 inches, dark brown, mottled, very friable silt loam

In places the lower part of the subsoil is yellowish red. Some areas are strongly sloping. In some severely eroded areas, the surface layer is silty clay loam.

Included with this soil in mapping are some small areas of Bucklick soils and areas of the moderately well drained Gatewood soils that have bedrock at a depth of 20 to 60 inches. These soils are mostly along small drainageways. They make up about 10 percent of the map unit.

Important properties of the Menfro soil—

Permeability: Moderate
Surface runoff: Very rapid
Available water capacity: High
Organic matter content: Moderately low
Shrink-swell potential: Moderate

Most areas are used for hay, pasture, or woodland. This soil is suited to hay and pasture. It is suited to row crops on a limited basis. If the soil is used for cultivated crops, the hazard of erosion is severe. Using a combination of conservation practices helps to prevent excessive soil loss. A system of conservation tillage that leaves crop residue on the surface after planting helps to control erosion. Many areas have smooth slopes and are large enough to be terraced and farmed on the contour. Terraces reduce the steepness of the slope. Narrow-base terraces or terraces that have grassed back slopes may be more desirable than conventional terraces if the soil is used for row crops. Contour stripcropping involves alternating permanent strips of grasses or legumes with row crops planted on the contour. The grass-legume strips minimize erosion and help to filter the sediments from runoff that would otherwise leave the field. Such systems are extremely effective, inexpensive, and flexible. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. This soil is well suited to switchgrass, ladino clover, red clover, tall fescue, and timothy. It is moderately well suited to big bluestem, indiangrass, alfalfa, and orchardgrass. When new seedings are being established, tilling on the contour, planting nurse crops, or leaving crop residue on the surface helps to prevent excessive erosion.

A significant acreage supports native forest. Much of the woodland could benefit from selective cutting and stand improvement. Some areas of abandoned farmland are reverting to forest. The hazard of erosion and the equipment limitation are management concerns. Establishing roads and skid trails on the contour helps to minimize the steepness and length of slopes and the concentration of water. In some places it may be necessary to yard the logs uphill to logging roads or skid trails. Seeding disturbed areas and constructing water bars across roads and trails may be necessary after harvesting is completed. Because of the slope, it may be necessary to plant seedlings by hand or direct seeding.

This soil is suitable for building site development if proper design and installation procedures are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Land shaping can modify the slope, or the dwellings can be designed so that they conform to the natural contour of the landscape. Septic tank absorption fields should be designed so that they operate across the slope, or the sewage can be piped to adjacent areas that are more suitable.

Low strength, the shrink-swell potential, the slope, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Some cut and fill may be necessary because of the slope, or the roads can be designed so that they conform to the natural contour of the landscape (fig. 7). Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IVe. The woodland ordination symbol is 3R.

10F—Gasconade-Rock outcrop complex, 14 to 35 percent slopes. This map unit consists of the very shallow and shallow, moderately steep and steep, somewhat excessively drained Gasconade soil and areas where dolomite bedrock is exposed. The Gasconade soil and the Rock outcrop occur in an intricate pattern on ridgetops and side slopes. Areas of this unit are known as "cedar glades." They are irregular in shape and range from about 10 to more than 80 acres in size. They are about 45 percent Gasconade soil and 40 percent Rock outcrop.

The typical sequence, depth, and composition of the layers of the Gasconade soil are as follows—

Surface layer:

0 to 2 inches, very dark brown, friable gravelly clay loam

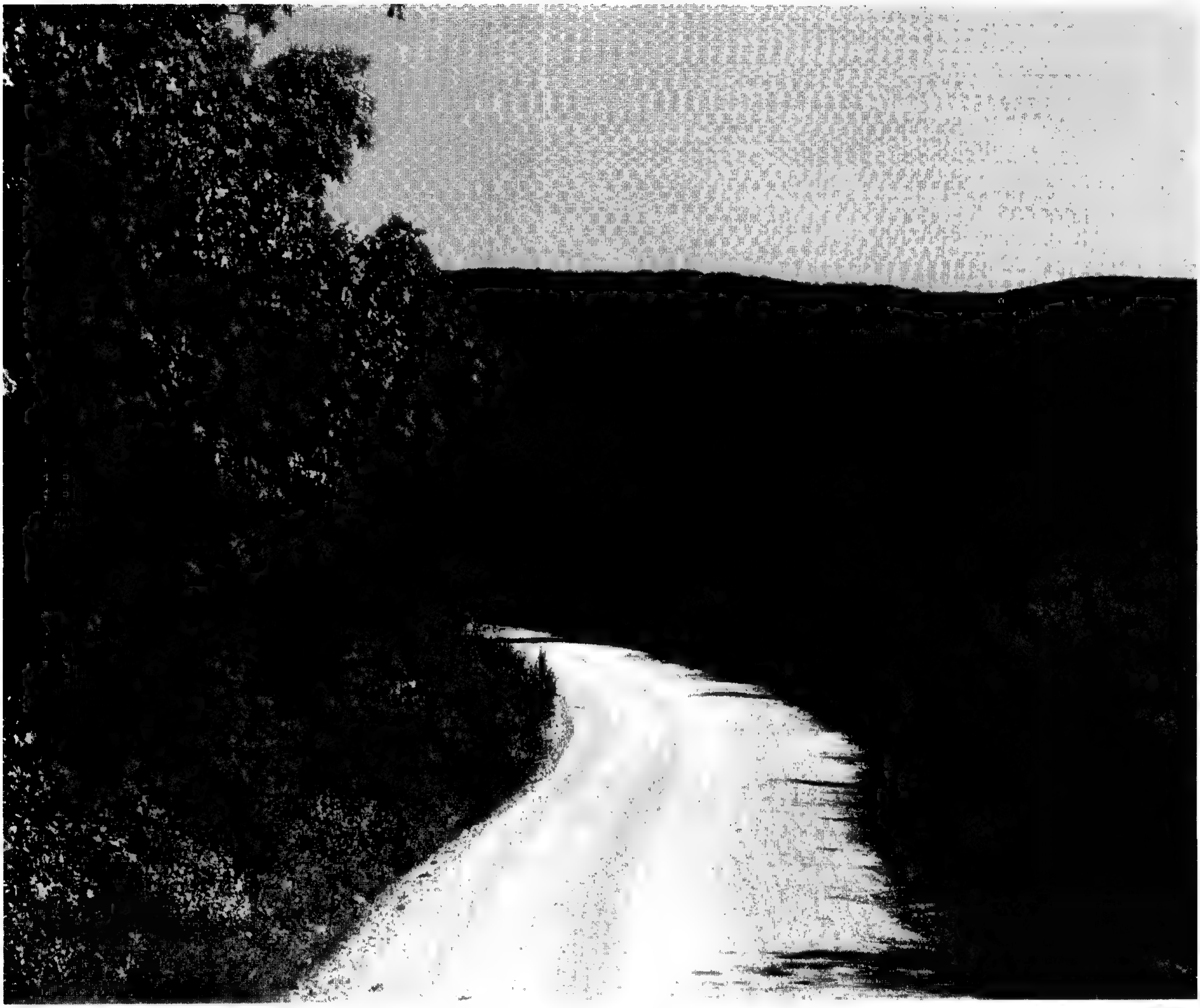


Figure 7.—Because of the slope, roads throughout the county have been constructed so that they follow the contour of the landscape. This road is in an area of Menfro silt loam, 14 to 20 percent slopes, eroded.

Subsoil:
- 2 to 10 inches, very dark grayish brown, firm very gravelly clay
- 10 to 18 inches, dark yellowish brown, very firm extremely gravelly clay

Bedrock:
- 18 inches, dolomite

In places flagstones cover 1 to 3 percent of the surface.

Included in mapping are some areas that have slopes ranging to as much as 60 percent or that have nearly vertical cliffs. Also included, mostly in the less sloping positions, are some areas of the moderately deep Gatewood soils. Included areas make up about 15 percent of the map unit.

Important properties of the Gasconade soil—

Permeability: Moderately slow
Surface runoff: Very rapid
Available water capacity: Very low
Organic matter content: Moderate

Shrink-swell potential: Moderate
Depth to bedrock: Less than 20 inches

Most areas are used as woodland. The Gasconade soil is best suited to trees. The hazard of erosion, the equipment limitation, seedling mortality, and windthrow are management concerns. Establishing roads and skid trails on the contour helps to minimize the steepness and length of slopes and the concentration of water. In some areas, it may be necessary to yard the logs uphill to logging roads or skid trails. Seeding disturbed areas and constructing water bars across roads and trails may be necessary after harvesting is completed. Because of limestone fragments throughout the surface layer, it may be necessary to plant seedlings by hand or direct seeding. Planting container-grown nursery stock improves the seedling survival rate. Reinforcement planting or replanting may be needed. Proper selection of tree species for planting is critical because only a few trees can survive the severe conditions in areas of this unit. Thinning the stands lightly and frequently minimizes windthrow damage.

The Gasconade soil is generally unsuitable for building site development because of the slope and the depth to bedrock.

The glades in this unit are unique ecological areas. They are the preferred habitat for several kinds of wildflowers and other plants and for rare species of reptiles and insects.

The land capability classification of the Gasconade soil is VIIe. The woodland ordination symbol is 2R.

11—Dockery silt loam, frequently flooded. This very deep, nearly level, somewhat poorly drained soil is on flood plains along large streams and their tributaries. It is subject to brief periods of flooding. Individual areas are long and narrow and range from about 10 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 6 inches, dark brown, very friable silt loam

Substratum:
6 to 21 inches, dark brown, mottled, very friable silt loam

Subsurface layer:
21 to 48 inches, brown, mottled, very friable silt loam
48 to 60 inches, dark yellowish brown and grayish brown, very friable silt loam

Some areas are only occasionally flooded.

Included with this soil in mapping are some small areas of well drained soils that have a sandy surface layer. These soils are along the banks of streams. Also included are areas of the poorly drained Racoon soils in the higher areas. Included soils make up about 15 percent of the map unit.

Important properties of the Dockery soil—

Permeability: Moderate
Surface runoff: Very slow
Available water capacity: Very high
Organic matter content: Moderate
Shrink-swell potential: Moderate
Seasonal high water table: At a depth of 2 to 3 feet

Most areas are used for row crops, pasture, or woodland. This soil is suited to corn, soybeans, small grain, and grasses and legumes. No significant limitations affect cultivated crops if the soil is protected from flooding and runoff from the uplands. Levees or flood-control structures minimize flood damage and crop losses. Diversions can protect the soil from excess runoff from the adjacent uplands. Short-season varieties can be planted at times that coincide with the part of the growing season when flooding is least likely. In some depressional areas, land grading or surface ditches may be needed to reduce wetness. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Wetness is a problem if this soil is used for hay or pasture. Pasture and hay species that tolerate wetness should be selected for planting. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the high water table. This soil is well suited to reed canarygrass. It is moderately well suited to switchgrass, ladino clover, red clover, tall fescue, and timothy. It is moderately suited to big bluestem, indiangrass, and alfalfa. Diversions can protect the soil from excess runoff from the adjacent uplands. Land grading or surface ditches help to remove excess water. Grazing should be restricted to periods when flooding is not likely.

This soil is suited to trees. Many small areas support native woodland. The equipment limitation is a management concern. Equipment should be used only when the soil is dry or frozen.

This soil is unsuitable for building site development because of the frequent flooding.

The land capability classification is IIIw. The woodland ordination symbol is 4W.

12—Bremer silty clay loam, rarely flooded. This very deep, nearly level, poorly drained soil is on high flood plains. It is subject to brief periods of flooding. Individual areas are irregular in shape and range from about 10 to more than 150 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 8 inches, black, friable silty clay loam

Subsurface layer:
8 to 15 inches, very dark gray, firm silty clay loam

Subsoil:
15 to 60 inches, very dark gray and dark gray, mottled, firm silty clay loam and silty clay

In some areas the surface layer is silt loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Auxvasse soils. These soils are around the perimeter of the mapped areas, nearest to the stream. They make up about 10 percent of the map unit.

Important properties of the Bremer soil—

Permeability: Moderately slow
Surface runoff: Very slow
Available water capacity: High
Organic matter content: High
Seasonal high water table: At a depth of 1 to 2 feet
Shrink-swell potential: High

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for pasture and hay. Wetness and the flooding are the main limitations affecting cultivated crops. The wetness is caused by hillside runoff and poor surface drainage. Diversions can protect the soil from excess runoff from the adjacent uplands. Surface drainage can be improved by land grading or surface ditches. Levees or flood-control structures minimize flood damage and crop losses. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

The flooding and the wetness are concerns if this soil is used for hay or pasture. Pasture and hay species that tolerate wetness should be selected for planting. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the high water table. This soil is moderately well suited to reed canarygrass. It is moderately suited to alsike clover and ladino clover. It is poorly suited or generally unsuited to most warm-season grasses, legumes, and cool-season grasses. Diversions can protect the soil from excess runoff from the adjacent uplands. Land grading or shallow ditches help to remove excess water. Grazing should be restricted to periods when flooding is not likely.

This soil is suited to trees. Wetness-tolerant species should be selected for planting. The equipment limitation, seedling mortality, and windthrow are management concerns. Equipment should be used only when the soil is dry or frozen. Planting container-grown nursery stock and ridging the soil before planting improve the seedling survival rate. Thinning the stands lightly and frequently minimizes windthrow damage.

This soil is unsuitable for building site development because of the flooding.

The land capability classification is IIIw. The woodland ordination symbol is 2W.

13A—Auxvasse silt loam, 0 to 3 percent slopes, rarely flooded. This very deep, nearly level and very gently sloping, somewhat poorly drained soil is on high flood plains. Most areas are subject to brief periods of flooding. Individual areas are irregular in shape and range from about 5 to more than 80 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 6 inches, grayish brown, very friable silt loam

Subsurface layer:
6 to 9 inches, grayish brown, mottled, very friable silt loam

Subsoil:
9 to 11 inches, brown, mottled, friable silt loam
11 to 23 inches, grayish brown, mottled, firm silty clay
23 to 33 inches, light brownish gray, mottled, firm silty clay

Substratum:
33 to 60 inches, grayish brown, mottled, friable silty clay loam

Included with this soil in mapping are some areas of the poorly drained Racoon soils. These soils are in the lower positions on the landscape. They make up about 5 percent of the map unit.

Important properties of the Auxvasse soil—

Permeability: Very slow
Surface runoff: Slow
Available water capacity: High
Organic matter content: Low
Seasonal high water table: Perched at a depth of 1 to 2 feet
Shrink-swell potential: High

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for pasture and hay. Wetness and the flooding are the main limitations affecting cultivated crops. The wetness is caused by hillside runoff and poor surface drainage. Diversions can protect the soil from excess

runoff from the adjacent uplands. Surface drainage can be improved by land grading or surface ditches. Levees or flood-control structures minimize flood damage and crop losses. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

The flooding and the wetness are concerns if this soil is used for hay or pasture. Pasture and hay species that tolerate wetness should be selected for planting. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the high water table. This soil is well suited to ladino clover. It is moderately well suited to big bluestem, indiangrass, switchgrass, alsike clover, tall fescue, and timothy. It is moderately suited to red clover and orchardgrass. Diversions can protect the soil from excess runoff from the adjacent uplands. Land grading or shallow ditches help to remove excess water. Grazing should be restricted to periods when flooding is not likely.

This soil is suited to trees. Wetness-tolerant species should be selected for planting. The equipment limitation, seedling mortality, and windthrow are management concerns. Equipment should be used only when the soil is dry or frozen. Planting container-grown nursery stock and ridging the soil before planting improve the seedling survival rate. Thinning the stands lightly and frequently minimizes windthrow damage.

This soil is unsuitable for building site development because of the flooding.

The land capability classification is IIIw. The woodland ordination symbol is 4W.

16—Waldron silty clay, occasionally flooded. This very deep, nearly level, somewhat poorly drained soil is on the flood plain along the Missouri River. Levees have been installed in most areas, but the soil is still subject to long periods of flooding. Individual areas are irregular in shape and range from about 10 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 9 inches, very dark grayish brown, firm silty clay

Substratum:
9 to 55 inches, stratified very dark grayish brown, dark grayish brown, and brown, firm silty clay and silty clay loam
55 to 60 inches, stratified very dark grayish brown and brown, friable silt loam and very fine sandy loam

In some places the surface layer is silty clay loam. Some areas that are not protected by levees are subject to frequent flooding. Some areas are ponded.

Included with this soil in mapping are areas of the well drained Haynie soils. These soils are on low natural levees on the flood plain. They make up about 5 percent of the map unit.

Important properties of the Waldron soil—

Permeability: Slow in the upper part, moderate in the lower part
Surface runoff: Very slow
Available water capacity: Moderate
Organic matter content: Moderate
Seasonal high water table: At a depth of 1 to 3 feet
Shrink-swell potential: High

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay. The flooding and wetness are the main management concerns. Maintenance and improvement of levees help to minimize flood damage, and surface ditches improve drainage. Deep tillage in the fall improves tilth and allows for earlier seeding in the spring. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

The flooding and the wetness are concerns if this soil is used for hay or pasture. Switchgrass and reed canarygrass generally can survive the long periods of flooding. This soil is moderately well suited to switchgrass, ladino clover, red clover, tall fescue, and timothy. It is moderately suited to big bluestem, indiangrass, and orchardgrass, but replanting may be necessary. Land grading or surface ditches help to remove excess water. Grazing should be restricted to periods when flooding is not likely.

This soil is suited to trees. The equipment limitation and seedling mortality are management concerns. Equipment should be used only when the soil is dry or frozen. Planting container-grown nursery stock and ridging the soil before planting improve the seedling survival rate.

This soil is unsuitable for building site development because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 11C.

17D—Wilderness gravelly silt loam, 9 to 14 percent slopes. This very deep, strongly sloping, moderately well drained soil is on the upper side slopes in the uplands. Individual areas are mostly long and narrow and range from about 10 to more than 80 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:

0 to 4 inches, dark brown, very friable gravelly silt loam

Subsurface layer:

4 to 17 inches, yellowish brown, very friable very gravelly silt loam

Subsoil:

17 to 27 inches, strong brown, firm extremely gravelly silt loam

27 to 42 inches, a fragipan of yellowish brown, mottled, extremely firm and brittle extremely gravelly silt loam

42 to 60 inches, dark brown and red, mottled, very firm gravelly clay

On most north- and east-facing foot slopes, the surface layer is silt loam.

Included with this soil in mapping are areas of the silty Union soils. These soils are in the less sloping areas on the middle parts of some ridges and on some north- and east-facing foot slopes. Also included are the somewhat excessively drained Coulstone soils on some of the lower side slopes. Included soils make up about 15 percent of the map unit.

Important properties of the Wilderness soil—

Permeability: Moderate above the fragipan, slow in the fragipan
Surface runoff: Rapid
Available water capacity: Very low
Organic matter content: Moderately low
Seasonal high water table: Perched at a depth of 1 to 2 feet
Shrink-swell potential: Moderate

Most areas support native forest. Some areas have been cleared and are used for pasture.

This soil is unsuited to cultivated crops and hayland. It can be used for pasture, but the hazard of erosion, droughtiness, and chert fragments in the surface layer are management concerns. Grasses and legumes that are drought resistant should be selected for planting. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the limited available water capacity and the fragipan, which restricts the depth to which roots can penetrate. The soil is moderately well suited to indiangrass, big bluestem, bromegrass, reed canarygrass, lespedeza, and birdsfoot trefoil. It is moderately suited to switchgrass, tall fescue, and orchardgrass. When new seedings are being established, broadcast seeding may be necessary because of the chert fragments on the surface. Planting nurse crops helps to prevent excessive erosion until the intended forage crop is established. Carefully maintaining the height and vigor of forage plants helps to prevent the formation of rills and gullies.

This soil is suited to trees. Stand improvement and selective cutting are needed in most areas. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock improves the seedling survival rate. The seedling mortality rate is generally much higher on south- and west-facing slopes than in other areas. Reinforcement planting or replanting may be needed. Thinning the stands lightly and frequently minimizes windthrow damage.

This soil is suitable for building site development and onsite waste disposal systems if proper design and installation procedures are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Land shaping can modify the slope, or the dwellings can be designed so that they conform to the natural contour of the landscape. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Excavation may be difficult because of the fragipan. Properly constructed sewage lagoons function adequately on this soil. The slope is a limitation. Grading the area helps to modify the slope, or the sewage can be piped to adjacent areas that are more suitable.

Wetness, the slope, and the potential for frost action are limitations on sites for local roads and streets. Some cut and fill may be necessary because of the slope, or the roads can be designed so that they conform to the natural contour of the landscape. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by wetness and by frost action.

The land capability classification is VIe. The woodland ordination symbol is 3D.

19—Haynie very fine sandy loam, occasionally flooded. This very deep, nearly level, well drained soil is in high areas on the flood plain along the Missouri River. Levees have been installed in most areas, but the soil is still subject to long periods of flooding. Individual areas are irregular in shape and range from about 20 to several hundred acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:

0 to 9 inches, very dark grayish brown, very friable very fine sandy loam

Substratum:

9 to 60 inches, stratified brown and yellowish

brown, very friable silt loam

In some places the surface layer is silty clay loam. Some areas that are not protected by levees are subject to frequent flooding.

Included with this soil in mapping are areas of the somewhat poorly drained Waldron soils in low narrow swales. Also included, in slightly elevated areas, are somewhat excessively drained soils that have sandy material in the lower part of the substratum. Included soils make up about 10 percent of the map unit.

Important properties of the Haynie soil—

Permeability: Moderate
Surface runoff: Very slow
Available water capacity: High
Organic matter content: Moderate

Most areas are used for row crops. Some areas are wooded. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay. The flooding is the main management concern. Maintenance and improvement of levees help to minimize flood damage. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

The flooding is a concern if this soil is used for hay or pasture. Switchgrass and reed canarygrass can generally survive the long periods of flooding. This soil is well suited to switchgrass, alfalfa, ladino clover, red clover, orchardgrass, tall fescue, and timothy. It is moderately well suited to big bluestem and indiangrass, but replanting may be necessary. Grazing should be restricted to periods when flooding is not likely.

This soil is suited to trees. Only slight limitations affect planting or harvesting.

This soil is unsuitable for building site development because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 11A.

20—Sarpy fine sand, frequently flooded. This very deep, nearly level, excessively drained soil is on natural levees along the channel on the Missouri River flood plain. It is subject to long periods of flooding. Individual areas are elongated and range from about 20 to more than 120 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 4 inches, dark brown, loose fine sand

Substratum:
4 to 26 inches, brown, loose fine sand
26 to 60 inches, brown, loose, stratified loamy fine sand

In some places the upper part of the substratum is very fine sandy loam.

Included with this soil in mapping are areas of the well drained Haynie soils that have loamy material throughout. These soils are along the perimeter of the mapped areas, away from the channel, in the slightly lower positions on the landscape. They make up about 5 percent of the map unit.

Important properties of the Sarpy soil—

Permeability: Rapid
Surface runoff: Very slow
Available water capacity: Low
Organic matter content: Low

Most areas are used as woodland. Some areas are used for pasture or hayland, and a few areas are used for row crops. This soil is suited to woodland and to grasses and legumes for hay. It is suited to small grain on a limited basis. The flooding and the low available water capacity are the main management concerns. The construction of levees is generally impractical because of the proximity to the main channel and the low investment return. Small grain crops, such as wheat and oats, are the only cash grain crops that can withstand the droughtiness caused by the low available water capacity. Regular additions of organic material improve fertility and increase the available water capacity.

The flooding is a concern if this soil is used for hay or pasture. Switchgrass and reed canarygrass can generally survive the long periods of flooding. Grazing should be restricted to periods when flooding is not likely.

This soil is suited to trees. Seedling mortality is a management concern. Planting container-grown nursery stock improves the seedling survival rate. Reinforcement planting or replanting may also be needed.

This soil is unsuitable for building site development because of the flooding.

The land capability classification is IVw. The woodland ordination symbol is 3S.

23F—Weingarten-Gatewood complex, 20 to 35 percent slopes. These steep, moderately well drained soils are on dissected north- and east-facing side slopes in the uplands. The very deep Weingarten soil is in areas between drainageways. The moderately deep Gatewood soil is in the less stable positions at the heads and on the lower sides of drainageways. Individual areas of this unit are elongated and range

from about 20 to more than 150 acres in size. They are about 50 percent Weingarten soil and 45 percent Gatewood and similar soils.

The typical sequence, depth, and composition of the layers of the Weingarten soil are as follows—

Surface layer:
0 to 2 inches, yellowish brown, very friable silt loam

Subsurface layer:
2 to 6 inches, yellowish brown, mottled, friable silt loam

Subsoil:
6 to 23 inches, brown, mottled, firm silty clay loam
23 to 36 inches, strong brown, mottled, very firm, somewhat brittle silt loam
36 to 55 inches, light brownish gray, mottled, very firm, somewhat brittle gravelly silty clay loam
55 to 65 inches, mottled strong brown and yellowish red, firm silty clay

In places, the subsoil is silty clay and the depth to bedrock is less than 60 inches. In some areas the lower part of the subsoil is not brittle.

Important properties of the Weingarten soil—

Permeability: Moderately slow
Surface runoff: Very rapid
Available water capacity: High
Organic matter content: Moderately low
Seasonal high water table: Perched at a depth of 2.5 to 4.0 feet
Shrink-swell potential: Moderate

The typical sequence, depth, and composition of the layers of the Gatewood soil are as follows—

Surface layer:
0 to 4 inches, very dark grayish brown, very friable gravelly silt loam

Subsurface layer:
4 to 9 inches, brown, very friable gravelly silt loam

Subsoil:
9 to 23 inches, strong brown, firm clay
23 to 36 inches, strong brown, mottled, firm clay

Bedrock:
36 inches, dolomite

In many places the depth to bedrock is more than 40 inches.

Important properties of the Gatewood soil—

Permeability: Slow
Surface runoff: Very rapid
Available water capacity: Low
Organic matter content: Low
Seasonal high water table: Perched at a depth of 1.5 to 3.0 feet
Shrink-swell potential: High
Depth to bedrock: 20 to 40 inches

Included with these soils in mapping are small areas of the shallow and very shallow Gasconade soils. These included soils are on the lower slopes that have primarily south or west aspects. They make up about 5 percent of the map unit.

Most areas of the Weingarten and Gatewood soils support native woodland and are used for timber production and as habitat for woodland wildlife. These soils are suited to trees. The hazard of erosion, the equipment limitation, and seedling mortality are management concerns. Establishing roads and skid trails on the contour helps to minimize the steepness and length of slopes and the concentration of water. In some places it may be necessary to yard the logs uphill to logging roads or skid trails. Seeding disturbed areas and constructing water bars across roads and trails may be necessary after harvesting is completed. Because of chert fragments throughout the surface layer in the Gatewood soil, it may be necessary to plant seedlings by hand or direct seeding. Planting container-grown nursery stock improves the seedling survival rate.

The Weingarten soil is suitable for building site development and onsite waste disposal systems if sites are carefully selected and proper design and installation procedures are used. The Gatewood soil is generally unsuitable for these uses because of the moderate depth to bedrock. Building sites on the Weingarten soil should be selected in places where areas downslope from the site are suitable for septic tank absorption fields or lagoons. Lengthening the lateral lines helps to overcome the restricted permeability, and the lines should be established across the slope. Also, the sewage can be piped to adjacent areas that are more suitable for lagoons or septic tank absorption fields. In areas of the Weingarten soil, constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Land shaping can modify the slope, or the dwellings can be designed so that they conform to the natural contour of the landscape.

Low strength, the shrink-swell potential, the slope, and the potential for frost action are limitations on sites for local roads and streets. The depth to bedrock is an additional limitation in areas of the Gatewood soil. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

Some cut and fill may be necessary because of the slope, or the roads can be designed so that they conform to the natural contour of the landscape. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling and by frost action. Blasting may be necessary to remove the bedrock in some areas of the Gatewood soil, or subgrade material can be hauled in from other areas.

The land capability classification is VIIe. The woodland ordination symbol of the Weingarten soil is 4R, and that of the Gatewood soil is 2R.

24F—Gatewood gravelly silt loam, 14 to 35 percent slopes. This moderately deep, moderately steep and steep, moderately well drained soil is on south- and west-facing side slopes in the uplands. Individual areas are irregular in shape and range from about 5 to more than 200 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 2 inches, very dark grayish brown, very friable gravelly silt loam

Subsurface layer:
2 to 10 inches, light yellowish brown, very friable gravelly silt loam

Subsoil:
10 to 30 inches, strong brown, mottled, firm and very firm clay

Bedrock:
30 inches, dolomite

In some places the subsoil is red clay.

Included with this soil in mapping are small, scattered areas of the very shallow and shallow Gasconade soils and some areas of the very deep Beemont soils in the higher positions on the landscape. Also included are small areas of the deep, well drained Bucklick soils and the moderately well drained Weingarten soils on the lower side slopes between small drainageways. Included soils make up about 15 percent of the map unit.

Important properties of the Gatewood soil—

Permeability: Slow
Surface runoff: Very rapid
Available water capacity: Low
Organic matter content: Moderately low
Seasonal high water table: Perched at a depth of 1.5 to 3.0 feet
Shrink-swell potential: High
Depth to bedrock: 20 to 40 inches

Most areas support native forest. Some areas have been cleared and are used for pasture. This soil is best suited to trees. The hazard of erosion and the equipment limitation are management concerns. Establishing roads and skid trails on the contour helps to minimize the steepness and length of slopes and the concentration of water. In some places it may be necessary to yard the logs uphill to logging roads or skid trails. Seeding disturbed areas and constructing water bars across roads and trails may be necessary after harvesting is completed. Because of the slope and chert fragments throughout the surface layer, it may be necessary to plant seedlings by hand or direct seeding.

This soil is unsuitable for cultivated crops and hayland. If the soil is used for pasture, the hazard of erosion, droughtiness, and the chert fragments in the surface layer are management concerns. Grasses and legumes that are drought resistant should be selected for planting because of the limited available water capacity. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the moderate depth to bedrock. The soil is moderately well suited to indiangrass, big bluestem, tall fescue, reed canarygrass, lespedeza, and birdsfoot trefoil. It is moderately suited to switchgrass and orchardgrass. When new seedings are being established, broadcast seeding may be necessary because of the slope and the chert fragments on the surface. Planting nurse crops helps to prevent excessive erosion until the intended forage crop is established. Carefully maintaining the height and vigor of the forage plants helps to prevent the formation of rills and gullies.

This soil is unsuitable for building site development because of the slope and the depth to bedrock.

The land capability classification is VIIe. The woodland ordination symbol is 2R.

26D—Beemont gravelly silt loam, 5 to 14 percent slopes. This very deep, moderately sloping and strongly sloping, moderately well drained soil is on the upper side slopes. Individual areas are irregular in shape and range from about 10 to more than 200 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 3 inches, dark brown, very friable gravelly silt loam

Subsurface layer:
3 to 18 inches, yellowish brown, very friable very gravelly loam

Subsoil:
18 to 28 inches, brown, mottled, firm clay
28 to 44 inches, strong brown, mottled, firm clay

44 to 50 inches, yellowish brown, mottled, firm clay
50 to 60 inches, yellowish brown, mottled, firm gravelly clay

On some north- and east-facing slopes, the surface layer is silt loam. In some areas on south- and west-facing side slopes, large stones and boulders are on the surface (fig. 8).

Included with this soil in mapping are some small areas of Union soils. These soils have a fragipan. They are on tapering ends of ridges and on north- and east-facing side slopes. They make up about 5 percent of the map unit.

Important properties of the Beemont soil—

Permeability: Moderately rapid in the upper part, very slow in the lower part
Surface runoff: Rapid
Available water capacity: Moderate
Organic matter content: Moderately low
Seasonal high water table: Perched at a depth of 4 to 6 feet
Shrink-swell potential: High

Most areas support native forest. Some areas have been cleared and are used for pasture. This soil is suited to trees. Stand improvement and selective cutting are needed in most areas. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock improves the seedling survival rate. The seedling mortality rate is generally much higher on south- and west-facing slopes than in other areas. Reinforcement planting or replanting may be needed. Thinning the stands lightly and frequently minimizes windthrow damage.

This soil is unsuitable for cultivated crops and hayland. If the soil is used for pasture, the hazard of erosion, droughtiness, and chert fragments in the surface layer are management concerns. Grasses and legumes that are drought resistant should be selected for planting. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the water table and the moderate available water capacity. The soil is moderately well suited to indiangrass, big bluestem, tall fescue, reed canarygrass, lespedeza, and birdsfoot trefoil. It is moderately suited to switchgrass and orchardgrass. When new seedings are being established, broadcast seeding may be necessary because of the chert fragments on the surface. Planting nurse crops helps to prevent excessive erosion until the intended forage crop is established. Carefully maintaining the height and vigor of forage plants helps to prevent the formation of rills and gullies.

This soil is suitable for building site development and onsite waste disposal systems if proper design and installation procedures are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Land shaping can modify the slope, or the dwellings can be designed so that they conform to the natural contour of the landscape. Properly constructed sewage lagoons function adequately. The slope and seepage are management concerns. Grading the area helps to modify the slope, and sealing the bottom of the lagoon helps to overcome the wetness. Also, the sewage can be piped to adjacent areas that are more suitable for lagoons.

Low strength, the shrink-swell potential, the slope, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Some cut and fill may be necessary because of the slope, or the roads can be designed so that they conform to the natural contour of the landscape. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is VIe. The woodland ordination symbol is 2C.

26F—Beemont gravelly silt loam, 14 to 35 percent slopes. This very deep, moderately steep and steep, moderately well drained soil is on side slopes. Individual areas are long and irregularly shaped and range from about 10 to more than 500 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 2 inches, dark brown, very friable gravelly silt loam

Subsurface layer:
2 to 7 inches, light yellowish brown, friable gravelly silt loam
7 to 17 inches, light yellowish brown, friable gravelly loam

Subsoil:
17 to 34 inches, strong brown, firm clay
34 to 46 inches, strong brown and reddish yellow, firm clay

Substratum:
46 to 60 inches, strong brown, firm clay loam

On some north- and east-facing slopes, the surface

Figure 8.—Sandstone stones and boulders are on the surface in some areas of Beemont gravelly silt loam, 5 to 14 percent slopes. They originate from large bedrock slabs, which are still intact in a few isolated glade areas.

layer is silt loam. In some areas on south- and west-facing side slopes, large stones and boulders are on the surface.

Included with this soil in mapping are some small areas of Union soils. These soils have a fragipan. They are on tapered ends of ridges between drainageways. They make up about 5 percent of the map unit.

Important properties of the Beemont soil—

Permeability: Moderately rapid in the upper part, very slow in the lower part
Surface runoff: Very rapid
Available water capacity: Moderate
Organic matter content: Moderately low
Seasonal high water table: Perched at a depth of 4 to 6 feet
Shrink-swell potential: High

Most areas support native forest. Some areas have been cleared and are used for pasture. This soil is best suited to trees. The hazard of erosion, the equipment limitation, seedling mortality, and windthrow are management concerns. Establishing roads and skid trails on the contour helps to minimize the steepness

and length of slopes and the concentration of water. In some places it may be necessary to yard the logs uphill to logging roads or skid trails. Seeding disturbed areas and constructing water bars across roads and trails may be necessary after harvesting is completed. Because of the slope and chert fragments throughout the surface layer, it may be necessary to plant seedlings by hand or direct seeding. Planting container-grown nursery stock improves the seedling survival rate. The seedling mortality rate is generally much higher on south- and west-facing slopes than in other areas. Reinforcement planting or replanting may be needed. Thinning the stands lightly and frequently minimizes windthrow damage.

This soil is unsuitable for cultivated crops and hayland. If the soil is used for pasture, the hazard of erosion, droughtiness, and chert fragments in the surface layer are management concerns. Grasses and legumes that are drought resistant should be selected for planting. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the water table and the moderate available water capacity. The soil is moderately well suited to indiangrass, big bluestem, tall fescue, reed canarygrass, lespedeza, and birdsfoot trefoil. It is moderately suited to switchgrass and orchardgrass. When new seedings are being established, broadcast seeding may be necessary because of the chert fragments on the surface. Planting nurse crops helps to prevent excessive erosion until the intended forage crop is established. Carefully maintaining the height and vigor of the forage plants helps to prevent the formation of rills and gullies.

This soil is suitable for building site development and onsite waste disposal systems if proper design and installation procedures are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Land shaping can modify the slope, or the dwellings can be designed so that they conform to the natural contour of the landscape. Properly constructed sewage lagoons function adequately. The slope and seepage are management concerns. Grading the area helps to modify the slope, and sealing the bottom of the lagoon helps to overcome the wetness. Also, the sewage can be piped to adjacent areas that are more suitable for lagoons.

Low strength, the shrink-swell potential, the slope, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Some cut and fill may be necessary because of the slope, or the roads can be designed so that they conform to the natural contour of the landscape. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is VIIe. The woodland ordination symbol is 2R.

28C—Weingarten silt loam, 5 to 9 percent slopes. This very deep, moderately sloping, moderately well drained soil is on ridgetops in the uplands. Individual areas are long and branching and range from about 10 to more than 200 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
- 0 to 7 inches, dark brown, very friable silt loam

Subsoil:
- 7 to 18 inches, brown, friable silty clay loam
- 18 to 27 inches, yellowish brown, firm silty clay loam
- 27 to 33 inches, brown, mottled, firm silty clay loam
- 33 to 53 inches, dark yellowish brown, mottled, firm and brittle silt loam
- 53 to 59 inches, yellowish brown, firm gravelly silty clay loam
- 59 to 65 inches, red, mottled, very firm silty clay

In some eroded areas the surface layer is silty clay loam. In places bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping are some small areas of Beemont soils that have a gravelly surface layer. These soils are in mounded areas on ridgetops. They make up about 5 percent of the map unit.

Important properties of the Weingarten soil—

Permeability: Moderately slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderately low
Seasonal high water table: Perched at a depth of 2.5 to 4.0 feet
Shrink-swell potential: Moderate

Most areas are used for row crops, hay, or pasture. This soil is suited to corn, soybeans, small grain, and grasses and legumes in proper crop rotations. If the soil is used for cultivated crops, erosion is a hazard. Using a combination of conservation practices helps to prevent excessive soil loss. A system of conservation tillage that leaves crop residue on the surface after

planting helps to control erosion. Many areas have smooth slopes and are large enough to be terraced and farmed on the contour. Contour stripcropping involves alternating permanent strips of grasses or legumes with row crops planted on the contour. The grass-legume strips minimize erosion and help to filter the sediments from runoff that would otherwise leave the field. Such systems are extremely effective, inexpensive, and flexible. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. This soil is well suited to big bluestem, indiangrass, switchgrass, and most other warm-season grasses; to alfalfa, ladino clover, red clover, and most other legumes; and to orchardgrass, tall fescue, timothy, and most other cool-season grasses. When new seedings are being established, tilling on the contour, planting nurse crops, or leaving crop residue on the surface helps to prevent excessive erosion.

This soil is suited to trees. Only slight limitations affect planting or harvesting.

This soil is suitable for building site development and onsite waste disposal systems if proper design and installation practices are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Properly constructed sewage lagoons function adequately. The slope and the wetness are limitations. Grading the area helps to modify the slope, and sealing the bottom of the lagoon helps to overcome the wetness.

Low strength, the shrink-swell potential, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

28D2—Weingarten silt loam, 9 to 14 percent slopes, eroded. This very deep, moderately well drained, strongly sloping soil is on ridgetops and the upper side slopes in the uplands. Much of the original surface soil has eroded away. In areas that are not protected by a plant cover, rills and small gullies form after rains of moderate intensity. Individual areas of this soil are irregular in shape and range from about 10 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 6 inches, dark yellowish brown, friable silt loam

Subsoil:
6 to 12 inches, yellowish brown, firm silt loam
12 to 19 inches, yellowish brown, firm silty clay loam
19 to 35 inches, mottled dark yellowish brown and brown, firm silty clay loam
35 to 50 inches, dark yellowish brown and grayish brown, firm silt loam
50 to 58 inches, dark yellowish brown and grayish brown, very firm and brittle silt loam
58 to 60 inches, yellowish brown, mottled, firm gravelly silty clay loam

In places the surface layer is more than 7 inches thick. In some areas bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping are some small areas of Beemont soils that have a gravelly surface layer. These soils are in mounded areas on ridgetops and on south- and west-facing slopes near incised drainageways. They make up about 5 percent of the map unit.

Important properties of the Weingarten soil—

Permeability: Moderately slow
Surface runoff: Rapid
Available water capacity: High
Organic matter content: Moderately low
Seasonal high water table: Perched at a depth of 2.5 to 4.0 feet
Shrink-swell potential: Moderate

Most areas are used for hay and pasture. This soil is suited to hay, pasture, and woodland (fig. 9). It is suited to row crops on a limited basis. The hazard of further erosion is severe if the soil is used for cultivated crops. Using a combination of conservation practices helps to prevent excessive soil loss. A system of conservation tillage that leaves crop residue on the surface after planting helps to control erosion. Many areas have smooth slopes and are large enough to be terraced and farmed on the contour. Terraces reduce the steepness of the slope. Narrow-base terraces or terraces that have grassed back slopes may be more desirable than conventional terraces if the soil is used for row crops. Contour stripcropping involves alternating permanent strips of grasses or legumes with row crops planted on

Figure 9.—An area of Weingarten silt loam, 9 to 14 percent slopes, eroded. This soil is suited to pasture, hay, and woodland.

the contour. The grass-legume strips minimize erosion and help to filter the sediments from runoff that would otherwise leave the field. Such systems are extremely effective, inexpensive, and flexible. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. This soil is well suited to switchgrass, ladino clover, red clover, tall fescue, and timothy. It is moderately well suited to big bluestem, indiangrass, alfalfa, and orchardgrass. When new seedings are being established, tilling on the contour, planting nurse crops, or leaving crop residue on the surface helps to prevent excessive erosion.

This soil is suited to trees. A small acreage supports native forest. Most of the wooded areas could benefit from selective cutting and stand improvement. Only slight limitations affect planting or harvesting.

This soil is suitable for building site development and onsite waste disposal systems if proper design and installation practices are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Land shaping can modify the slope, or the dwellings can be designed so that they conform to the natural contour of the landscape. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Properly constructed sewage lagoons function adequately. The slope and the wetness are limitations. Grading the area helps to modify the slope, and sealing the bottom of the lagoon helps to overcome the wetness. Also, the sewage can be piped to adjacent areas that are more suitable for lagoons.

Low strength, the shrink-swell potential, the slope, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Some cut and fill may be necessary because of the slope, or the roads can be

designed so that they conform to the natural contour of the landscape. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IVe. The woodland ordination symbol is 4A.

28E2—Weingarten silt loam, 14 to 20 percent slopes, eroded. This very deep, moderately well drained, moderately steep soil is on side slopes. Much of the original surface soil has eroded away. The remaining surface soil has been mixed with the upper part of the subsoil by tillage. In areas that are not protected by a plant cover, rills and small gullies form after rains of moderate intensity. Individual areas of this soil are irregular in shape and range from about 20 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 7 inches, dark brown, very friable silt loam

Subsoil:
7 to 10 inches, strong brown, friable silty clay loam
10 to 18 inches, yellowish brown, friable silty clay loam
18 to 25 inches, brown, mottled, firm silty clay loam
25 to 36 inches, strong brown, mottled, friable silty clay loam
36 to 47 inches, strong brown, mottled, very firm, slightly brittle silt loam
47 to 60 inches, yellowish brown, mottled, friable gravelly silty clay loam

In some severely eroded areas, the surface layer is silty clay loam. In places the surface layer is gravelly silt loam because of downslope movement from adjacent soils that formed in residuum.

Included with this soil in mapping are some scattered small areas of Coulstone soils that are gravelly throughout. These soils make up about 5 percent of the map unit.

Important properties of the Weingarten soil—

Permeability: Moderately slow
Surface runoff: Very rapid
Available water capacity: High
Organic matter content: Moderately low
Seasonal high water table: Perched at a depth of 2.5 to 4.0 feet
Shrink-swell potential: Moderate

Most areas are used for hay, pasture, or woodland. This soil is unsuitable for cultivated crops because of the slope and because of marginal productivity. It is best suited to hay, pasture, and trees.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. This soil is well suited to switchgrass, ladino clover, red clover, tall fescue, and timothy. It is moderately well suited to big bluestem, indiangrass, alfalfa, and orchardgrass. When new seedings are being established, tilling on the contour, planting nurse crops, or leaving crop residue on the surface helps to prevent excessive erosion.

This soil is suited to trees. A small acreage supports native forest. Some areas of abandoned farmland are reverting to forest. Most of the wooded areas could benefit from selective cutting and stand improvement. The hazard of erosion and the equipment limitation are management concerns. Establishing roads and skid trails on the contour helps to minimize the steepness and length of slopes and the concentration of water. In some places it may be necessary to yard the logs uphill to logging roads or skid trails. Seeding disturbed areas and constructing water bars across roads and trails may be necessary after harvesting is completed. Because of the slope, it may be necessary to plant seedlings by hand or direct seeding.

This soil is suitable for building site development and onsite waste disposal systems if proper design and installation practices are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Land shaping can modify the slope, or the dwellings can be designed so that they conform to the natural contour of the landscape. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Properly constructed sewage lagoons function adequately. The slope and the wetness are limitations. Grading the area helps to modify the slope, and sealing the bottom of the lagoon helps to overcome the wetness. Also, the sewage can be piped to adjacent areas that are more suitable for lagoons.

Low strength, the shrink-swell potential, the slope, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Some cut and fill may be necessary because of the slope, or the roads can be designed so that they conform to the natural contour of the landscape. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is VIe. The woodland ordination symbol is 4R.

31D—Bucklick-Beemont-Moko complex, 5 to 14 percent slopes. These moderately sloping and strongly sloping soils are on ridgetops and the upper side slopes in the uplands. The deep, well drained Bucklick soil is in saddles and on north- and east-facing side slopes. The very deep, moderately well drained Beemont soil is in mounded areas and on south- and west-facing slopes in the higher areas. The very shallow, somewhat excessively drained Moko soil is on south- and west-facing slopes in the lower positions on the landscape and in some deep saddles. Individual areas of this unit are long and branching and range from about 10 to more than 100 acres in size. They are about 40 percent Bucklick soil, 35 percent Beemont soil, and 20 percent Moko soil.

The typical sequence, depth, and composition of the layers of the Bucklick soil are as follows—

Surface layer:
0 to 5 inches, brown, friable silt loam

Subsoil:
5 to 8 inches, strong brown, friable silty clay loam
8 to 16 inches, strong brown, firm silty clay loam
16 to 25 inches, yellowish red, mottled, firm silty clay
25 to 31 inches, yellowish red, mottled, firm silty clay loam
31 to 37 inches, yellowish red, mottled, firm very gravelly silty clay
37 to 53 inches, yellowish red, mottled, firm gravelly silty clay

Bedrock:
53 inches, dolomite

In some places the subsoil is silty clay loam throughout.

Important properties of the Bucklick soil—

Permeability: Moderate
Surface runoff: Rapid
Available water capacity: Moderate
Organic matter content: Moderate
Shrink-swell potential: High
Depth to bedrock: 40 to 60 inches

The typical sequence, depth, and composition of the layers of the Beemont soil are as follows—

Surface layer:
0 to 4 inches, dark brown, very friable gravelly silt loam

Subsurface layer:
4 to 21 inches, yellowish brown, friable gravelly silt loam

Subsoil:
21 to 27 inches, yellowish red and yellowish brown, firm clay
27 to 37 inches, strong brown, firm clay
37 to 60 inches, brownish yellow, mottled, firm clay

Bedrock:
60 inches, fire clay

In some places bedrock is at a depth of 20 to 40 inches.

Important properties of the Beemont soil—

Permeability: Very slow
Surface runoff: Rapid
Available water capacity: Moderate
Organic matter content: Moderately low
Seasonal high water table: Perched at a depth of 4 to 6 feet
Shrink-swell potential: High

The typical sequence, depth, and composition of the layers of the Moko soil are as follows—

Surface layer:
0 to 1 inch, very dark grayish brown, friable very flaggy silt loam

Subsoil:
1 to 6 inches, very dark grayish brown, friable very flaggy silt loam

Bedrock:
6 inches, dolomite

In some places the soil is 10 to 20 inches deep.

Important properties of the Moko soil—

Permeability: Moderate
Surface runoff: Rapid
Available water capacity: Very low (less than 3 inches)
Organic matter content: Moderate
Depth to bedrock: Less than 10 inches

Included with these soils in mapping are some small areas of Union soils. These included soils have a fragipan. They are on the summits of ridgetops. They make up about 5 percent of the map unit.

Most areas of the Bucklick, Beemont, and Moko soils support native woodland. They are used mainly for timber production and as habitat for woodland wildlife. The Bucklick soil is suited to cultivated crops. The Beemont soil is not suited because of the gravelly surface layer, and the Moko soil is not suited because of the depth to bedrock. Bucklick and Beemont soils are suitable for pasture and hayland, but they occur in areas that are too small and segmented for row crops, hay, or pasture. The major soils in this map unit are

best suited to trees. The equipment limitation, seedling mortality, and windthrow are management concerns. Because of rock fragments throughout the surface layer in the Beemont and Moko soils, it may be necessary to plant seedlings by hand or direct seeding. Planting container-grown nursery stock improves the seedling survival rate. Thinning the stands lightly and frequently minimizes windthrow damage. In areas of the Moko soil, proper selection of species for planting is critical because only a few trees can survive the severe conditions.

The glades associated with the Moko soil are unique ecological areas. They are the preferred habitat for several kinds of wildflowers and other plants and for rare species of reptiles and insects.

The Moko soil is generally unsuitable for building site development because of the very shallow depth to bedrock. The Bucklick and Beemont soils are suitable for this use if sites are carefully selected and proper design and installation procedures are used. Building sites on the Bucklick and Beemont soils should be selected in places where areas downslope from the sites are suitable for septic tank absorption fields or lagoons. In areas of the Bucklick and Beemont soils, constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Blasting may be needed to remove the bedrock if the Bucklick soil is used as a site for dwellings with basements, or the dwellings can be designed so that they compensate for the limited depth to bedrock. In areas of the Beemont soil, installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Land shaping can modify the slope, or the dwellings can be designed so that they conform to the natural contour of the landscape. If these soils are used as sites for sewage lagoons, the slope and the wetness are concerns. Grading the area helps to modify the slope, and sealing the bottom of the lagoon helps to overcome the wetness and to prevent the contamination of ground water. Also, the sewage can be piped to adjacent areas that are more suitable for lagoons.

The depth to bedrock, low strength, the shrink-swell potential, the slope, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Some cut and fill may be necessary because of the slope, or the roads can be designed so that they conform to the natural contour of the landscape. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling and by frost action. Blasting may be needed to remove the bedrock in some areas of the Moko soil, or subgrade material can be hauled in from other areas.

The land capability classification is IVe for the Bucklick soil, VIe for the Beemont soil, and VIIs for the Moko soil. The woodland ordination symbol is 3A for the Bucklick soil, 2C for the Beemont soil, and 2D for the Moko soil.

32—Pits, quarries. Pits are areas from which fire clay, limestone, dolomite, or sandstone has been quarried. Individual areas are irregular in shape and range from about 5 to more than 20 acres in size.

Quarries are areas where present excavation is taking place and the surrounding areas are used for stockpiling (fig. 10), quarrying activities, or equipment operations. Most quarries are on steep, south-facing valley slopes where bedrock is exposed or is at a shallow depth. This unit has some of the larger clay mines in the county, from which refractory clays have been mined.

No land capability classification or woodland ordination symbol is assigned.

35A—Glensted silt loam, 1 to 2 percent slopes. This very deep, nearly level, poorly drained soil is on the central part of broad upland divides. Individual areas are long and branching and range from about 40 to several hundred acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 7 inches, dark brown, friable silt loam

Subsoil:
7 to 25 inches, dark grayish brown, mottled, firm silty clay
25 to 35 inches, grayish brown, mottled, firm silty clay loam

Substratum:
35 to 65 inches, light brownish gray, mottled, very firm clay loam

In some areas the soil is gently sloping.

Important soil properties—

Permeability: Slow
Surface runoff: Slow
Available water capacity: High
Organic matter content: Moderate
Seasonal high water table: Perched at a depth of 0.5 foot to 1.5 feet
Shrink-swell potential: High

Most areas are used for row crops, hay, or pasture.

Figure 10.—Pennsylvanian clay deposits are mined for refractory brick material in this area of Pits, quarries. Leaving the stockpiles exposed results in the disintegration of large stones and boulders into smaller fragments.

This soil is suited to corn, soybeans, small grain, and grasses and legumes in proper crop rotations. If the soil is used for cultivated crops, erosion is a hazard. Using a combination of conservation practices helps to prevent excessive soil loss. A system of conservation tillage that leaves crop residue on the surface after planting helps to control erosion. Most areas are too narrow to be managed independently but can be included with adjacent soils for management with terrace systems and contour farming. Contour stripcropping involves alternating permanent strips of grasses or legumes with row crops planted on the contour. The grass-legume strips minimize erosion and help to filter the sediments from runoff that would otherwise leave the field. Such systems are extremely effective, inexpensive, and flexible. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Pasture and hay species that tolerate wetness should be selected for planting. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the perched water table. This soil is moderately well suited to switchgrass and reed canarygrass. It is moderately suited to big bluestem, indiangrass, alsike clover, ladino clover, and tall fescue. It is poorly suited to red clover and timothy. When new seedings are being established, tilling on the contour, planting nurse crops, or leaving crop residue on the surface helps to prevent excessive erosion.

This soil is suited to building site development and onsite waste disposal systems if proper design and

installation procedures are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Properly constructed sewage lagoons function adequately. The wetness is a limitation. It can be overcome by sealing the bottom of the lagoon.

The shrink-swell potential, low strength, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling, by wetness, and by frost action.

The land capability classification is IIe. No woodland ordination symbol is assigned.

35B—Glensted silt loam, 2 to 5 percent slopes. This very deep, gently sloping, poorly drained soil is on broad upland divides. Individual areas are elongated and range from about 40 to several hundred acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 8 inches, dark brown, very friable silt loam

Subsoil:
8 to 19 inches, dark grayish brown, mottled, firm silty clay
19 to 54 inches, grayish brown, mottled, firm silty clay loam

Substratum:
54 to 60 inches, grayish brown, mottled, firm silty clay

In some eroded areas the surface layer is silty clay loam.

Included with this soil in mapping are the somewhat poorly drained Marion soils in nearly level areas and the moderately well drained Union soils on narrow ridges. Marion soils do not have a dark surface layer. Union soils have a fragipan. Included soils make up about 5 percent of the map unit.

Important properties of the Glensted soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Seasonal high water table: Perched at a depth of 0.5 foot to 1.5 feet
Shrink-swell potential: High

Most areas are used for row crops, hay, or pasture. This soil is suited to corn, soybeans, small grain, and grasses and legumes in proper crop rotations. If the soil is used for cultivated crops, erosion is a hazard. Using a combination of conservation practices helps to prevent excessive soil loss. A system of conservation tillage that leaves crop residue on the surface after planting helps to control erosion. Many areas have smooth slopes and are large enough to be terraced and farmed on the contour. Cuts made during the construction of terraces can expose the clayey subsoil, which cannot be easily tilled, is low in fertility and available water, and may require special management practices. Covering the exposed channel with topsoil from adjacent areas helps to prevent exposing the clayey subsoil. Contour stripcropping involves alternating permanent strips of grasses or legumes with row crops planted on the contour. The grass-legume strips minimize erosion and help to filter the sediments from runoff that would otherwise leave the field. Such systems are extremely effective, inexpensive, and flexible. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Pasture and hay species that tolerate wetness should be selected for planting. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the perched water table. This soil is moderately well suited to switchgrass and reed canarygrass. It is moderately suited to big bluestem, indiangrass, alsike clover, ladino clover, and tall fescue. It is poorly suited to red clover and timothy. When new seedings are being established, tilling on the contour, planting nurse crops, or leaving crop residue on the surface helps to prevent excessive erosion.

This soil is suited to building site development and onsite waste disposal systems if proper design and installation procedures are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Properly constructed sewage lagoons function adequately. The slope and the wetness are limitations. Grading the area helps to modify the slope, and sealing

the bottom of the lagoon helps to overcome the wetness.

The shrink-swell potential, low strength, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling, by wetness, and by frost action.

The land capability classification is IIIe. No woodland ordination symbol is assigned.

37—Marion silt loam. This very deep, nearly level, somewhat poorly drained soil is on broad upland divides. Individual areas are irregular in shape and range from about 5 to more than 20 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 8 inches, brown, very friable silt loam

Subsurface layer:
8 to 12 inches, pale brown, very friable silt loam

Subsoil:
12 to 30 inches, yellowish brown, mottled, firm silty clay
30 to 41 inches, grayish brown, mottled, firm silty clay loam

Substratum:
41 to 60 inches, grayish brown, mottled, friable silty clay loam

In some places the upper part of the subsoil is dark grayish brown.

Included with this soil in mapping are small areas of the moderately well drained Union soils that have a fragipan. These soils are on narrow ridgetops. They make up about 10 percent of the map unit.

Important properties of the Marion soil—

Permeability: Very slow
Surface runoff: Slow
Available water capacity: High
Organic matter content: Moderately low
Seasonal high water table: Perched at a depth of 1 to 2 feet
Shrink-swell potential: High

Most areas are used for hay, pasture, or row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for pasture and hay. Wetness caused by poor surface drainage is the main limitation affecting cultivated crops. Surface drainage can be improved by land grading or surface ditches. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Pasture and hay species that tolerate wetness should be selected for planting. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the water table. This soil is well suited to ladino clover. It is moderately well suited to big bluestem, indiangrass, switchgrass, alsike clover, tall fescue, and timothy. It is moderately suited to red clover and orchardgrass. Land grading or shallow ditches help to remove excess water.

This soil is suited to trees. Wetness-tolerant species should be selected for planting. The equipment limitation, seedling mortality, and windthrow are management concerns. Equipment should be used only when the soil is dry or frozen. Planting container-grown nursery stock and ridging the soil before planting improve the seedling survival rate. Thinning the stands lightly and frequently minimizes windthrow damage.

This soil is suited to building site development and onsite waste disposal systems if proper design and installation procedures are used. Constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Properly constructed sewage lagoons function adequately.

The shrink-swell potential, low strength, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling, by wetness, and by frost action.

The land capability classification is IIIw. The woodland ordination symbol is 2W.

39—Nolin silt loam, frequently flooded. This very deep, nearly level, well drained soil is on flood plains along large streams and their tributaries. It is subject to brief periods of flooding. Individual areas are elongated and range from about 10 to more than 500 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 9 inches, dark brown, very friable silt loam

Subsoil:
9 to 36 inches, dark brown, friable silt loam

Substratum:
36 to 60 inches, dark brown, friable silt loam

In some areas the upper part of the substratum is mottled. In places the substratum is sandy loam below a depth of 40 inches. Many areas are slightly higher and are only occasionally flooded.

Included with this soil in mapping are some small areas of the loamy Pope soils near the banks of streams. These soils make up about 10 percent of the map unit.

Important properties of the Nolin soil—

Permeability: Moderate
Surface runoff: Very slow
Available water capacity: Very high
Organic matter content: Moderately low

Most areas are used for row crops (fig. 11). This soil is suited to corn, soybeans, small grain, and grasses and legumes. No significant limitations affect cultivated crops if the soil is protected from flooding. Short-season varieties can be planted at times that coincide with the part of the growing season when flooding is least likely. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Flooding is the main concern if this soil is used for hay or pasture. The soil is well suited to switchgrass, alfalfa, ladino clover, red clover, orchardgrass, tall fescue, and timothy. It is moderately well suited to big bluestem and indiangrass. Grazing should be restricted to periods when flooding is not likely.

This soil is suited to trees. Many small areas support native woodland. Many of the wooded areas could benefit from selective cutting and stand improvement. The equipment limitation is a management concern. Equipment should be used only when the soil is dry or frozen.

This soil is unsuitable for building site development because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 8W.

43—Cedargap gravelly loam, frequently flooded. This very deep, nearly level, well drained soil is on narrow flood plains along small streams. It is subject to brief periods of flooding. Individual areas are long and narrow and range from about 10 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 10 inches, very dark grayish brown, very friable gravelly loam

Subsurface layer:
10 to 26 inches, very dark grayish brown and dark brown, friable extremely gravelly loam
26 to 44 inches, dark brown and very dark gray, friable very gravelly loam

Substratum:
44 to 53 inches, dark yellowish brown and dark brown, firm extremely gravelly loam
53 to 60 inches, dark brown, very firm extremely cobbly clay

In some places the surface soil is dark grayish brown or brown.

Included with this soil in mapping are areas of Gladden and Pope soils. These soils are at the slightly higher elevations, away from the main stream channel. Gladden soils do not have stones and gravel in the upper part. Pope soils are loamy throughout. Included soils make up about 15 percent of the map unit.

Important properties of the Cedargap soil—

Permeability: Moderate in the upper part, very slow in the lower part
Surface runoff: Very slow
Available water capacity: Low
Organic matter content: Moderate

Most areas are used for hay, pasture, or woodland. This soil is generally not used for cultivated crops because of the gravel and stones throughout the profile, the low available water capacity, and the frequent flooding (fig. 12).

Flooding is the main concern if this soil is used for hay or pasture. The soil is well suited to switchgrass, tall fescue, and ladino clover. It is moderately well suited to indiangrass, orchardgrass, bromegrass, and lespedeza. It is only moderately suited to alfalfa. Grazing should be restricted to periods when flooding is not likely.

A significant acreage supports native forest. Small acreages of abandoned pasture and cropland are reverting to forest. Most of the wooded areas could benefit from selective cutting and stand improvement. Seedling mortality is a management concern. Planting container-grown nursery stock improves the seedling survival rate. Reinforcement planting or replanting may also be needed.

Figure 11.—Soybean stubble and corn in an area of Nolin silt loam, frequently flooded.

This soil is unsuitable for building site development because of the flooding.

The land capability classification is IIIw. The woodland ordination symbol is 3F.

45—Pope fine sandy loam, occasionally flooded. This very deep, nearly level, well drained soil is on flood plains along large streams and their tributaries. It is subject to brief periods of flooding. Individual areas are elongated and range from about 10 to more than 80 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 10 inches, brown, very friable fine sandy loam

Subsoil:
10 to 34 inches, dark yellowish brown, very friable loam

Substratum:
34 to 60 inches, dark yellowish brown, very friable loam

In some places the soil is silty throughout. Some high areas are subject to only rare flooding.

Included with this soil in mapping are areas of Cedargap soils. These soils are gravelly throughout and are in areas next to the stream channel. Also included are frequently flooded soils adjacent to the channel that are loamy sand throughout. Included soils make up about 10 percent of the map unit.

Important properties of the Pope soil—

Permeability: Moderate
Surface runoff: Very slow
Available water capacity: High
Organic matter content: Moderately low

Most areas are used for row crops. This soil is suited to corn, soybeans, small grain, and grasses and legumes. No significant limitations affect cultivated crops if the soil is protected from flooding. Levees or flood-control structures minimize flood damage and crop losses. Short-season varieties can be planted at times that coincide with the part of the growing season when flooding is least likely. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Flooding is the main concern if this soil is used for

Figure 12.—Many small gravel-bottomed streams overflow frequently in areas of Cedargap gravelly loam, frequently flooded.

hay or pasture. The soil is well suited to switchgrass, alfalfa, ladino clover, red clover, orchardgrass, tall fescue, and timothy. It is moderately well suited to big bluestem and indiangrass. Grazing should be restricted to periods when flooding is not likely.

This soil is suited to trees. Many small areas support native woodland. Much of the woodland could benefit from selective cutting and stand improvement. Only slight limitations affect planting or harvesting.

This soil is unsuitable for building site development because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 7A.

49A—Gladden loam, 0 to 3 percent slopes, frequently flooded. This very deep, nearly level and very gently sloping, well drained soil is on flood plains along small streams. It is subject to brief periods of flooding. Individual areas are long and narrow and range from 10 to 200 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:

0 to 9 inches, dark brown, very friable loam

Subsoil:

9 to 23 inches, brown, very friable loam

23 to 36 inches, brown, very friable sandy loam

Substratum:

36 to 42 inches, dark yellowish brown, very friable gravelly fine sandy loam

42 to 60 inches, dark yellowish brown, very friable extremely gravelly sandy loam

In some places the soil is loamy throughout. Some areas in the higher positions are only occasionally flooded.

Included with this soil in mapping are areas of the

silty Nolin soils on the wider flood plains, the poorly drained Racoon soils on low terraces, and the gravelly Cedargap soils on narrow flood plains along small stream channels. Included soils make up about 15 percent of the map unit.

Important properties of the Gladden soil—

Permeability: Moderate
Surface runoff: Very slow
Available water capacity: Moderate
Organic matter content: Moderate

Most areas are used for hay, pasture, or woodland. A few areas are used for row crops. This soil is suited primarily to small grain and to grasses and legumes. Insufficient soil moisture is a problem affecting summer crops because of the moderate available water capacity. Grain sorghum and winter wheat, which are inherently stress tolerant, are the most common crops. If corn is grown, it should be planted early in spring. Large plant populations should be avoided. Most of the flooding occurs before the spring growing season, but planting can be delayed and crops may be damaged in some years. Flood-control structures minimize flood damage and crop losses. Short-season crops can be planted at times that coincide with the part of the growing season when flooding is least likely. Returning crop residue to the soil or applying regular additions of other organic material improves fertility, helps to prevent crusting, and increases the rate of water infiltration.

Flooding is the main concern if this soil is used for hay or pasture. The soil is well suited to switchgrass, tall fescue, and ladino clover. It is moderately well suited to indiangrass, orchardgrass, bromegrass, and lespedeza. It is only moderately suited to alfalfa. Grazing should be restricted to periods when flooding is not likely.

This soil is suited to trees. Many small areas support native woodland. Much of the woodland could benefit from selective cutting and stand improvement. The equipment limitation is a management concern. Equipment should be used only when the soil is dry or frozen.

This soil is unsuitable for building site development because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 4W.

51F—Beemont-Ramsey-Rock outcrop complex, 14 to 35 percent slopes. This map unit consists of Rock outcrop and areas of moderately steep and steep soils on the upper side slopes in the uplands. The very deep, moderately well drained Beemont soil is in horizontal bands between exposures of sandstone bedrock. The shallow, somewhat excessively drained Ramsey soil is slightly above the bedrock exposures. Individual areas of this unit are long and irregularly shaped and range from about 6 to more than 1,000 acres in size. They are about 50 percent Beemont soil, 20 percent Ramsey soil, and 15 percent Rock outcrop.

The typical sequence, depth, and composition of the layers of the Beemont soil are as follows—

Surface layer:
0 to 5 inches, brown, friable gravelly loam

Subsoil:
5 to 15 inches, dark yellowish brown, friable gravelly loam
15 to 24 inches, weak red and yellowish red, mottled, firm clay
24 to 60 inches, dark reddish gray and dark reddish brown, mottled, firm clay

In some areas the depth to bedrock is 20 to 40 inches. In places the subsoil is very gravelly clay or very cobbly clay.

Important properties of the Beemont soil—

Permeability: Very slow
Surface runoff: Very rapid
Available water capacity: Moderate
Organic matter content: Moderately low
Seasonal high water table: Perched at a depth of 4 to 6 feet
Shrink-swell potential: High

The typical sequence, depth, and composition of the layers of the Ramsey soil are as follows—

Surface layer:
0 to 1 inch, very dark grayish brown, very friable fine sandy loam

Subsurface layer:
1 to 5 inches, yellowish brown, friable fine sandy loam

Subsoil:
5 to 9 inches, yellowish brown, friable fine sandy loam
9 to 13 inches, light yellowish brown, friable fine sandy loam

Bedrock:
13 inches, sandstone

In some places the depth to sandstone is less than 10 inches.

Important properties of the Ramsey soil—

Permeability: Rapid
Surface runoff: Very rapid
Available water capacity: Very low

Organic matter content: Low

Included in mapping are areas of the silty Weingarten soils on some north- and east-facing side slopes. These soils make up about 15 percent of the map unit.

Most areas of this unit support woodland and are used mainly for timber production and as habitat for woodland wildlife. The Beemont soil has properties that are suitable for pasture or hayland, but it generally occurs in areas that are too narrow and segmented for these uses. The major soils in this unit are best suited to trees. The hazard of erosion, the equipment limitation, seedling mortality, and windthrow are management concerns. Establishing roads and skid trails on the contour helps to minimize the steepness and length of slopes and the concentration of water. In some places it may be necessary to yard the logs uphill to logging roads or skid trails. Seeding disturbed areas and constructing water bars across roads and trails may be necessary after harvesting is completed. Because of rock fragments throughout the surface layer, it may be necessary to plant seedlings by hand or direct seeding. Planting container-grown nursery stock improves the seedling survival rate. Thinning the stands lightly and frequently minimizes windthrow damage. In areas of the Ramsey soil, proper selection of species for planting is critical because only a few trees can survive the severe conditions.

The glades associated with the Ramsey soil are unique ecological areas. They are the preferred habitat for several kinds of wildflowers and other plants and for rare species of reptiles and insects.

The Ramsey soil and the Rock outcrop are generally unsuitable for building site development. The Beemont soil is suitable for this use if the sites are carefully selected and proper design and installation procedures are used. Building sites should be selected in places where areas downslope from the sites are suitable for septic tank absorption fields or lagoons. In areas of the Beemont soil, constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Land shaping can modify the slope, or the dwellings can be designed so that they conform to the natural contour of the landscape. Properly constructed sewage lagoons function adequately. The slope and seepage are limitations. Grading the area helps to modify the slope, and sealing the bottom of the lagoon helps to overcome the wetness. Also, the sewage can be piped to adjacent areas that are more suitable for lagoons.

The depth to bedrock, low strength, the shrink-swell potential, the slope, and the potential for frost action are limitations on sites for local roads and streets. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Some cut and fill may be necessary because of the slope, or the roads can be designed so that they conform to the natural contour of the landscape. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling and by frost action. Blasting may be needed to remove the bedrock in some areas of the Ramsey soil, or subgrade material can be hauled in from other areas.

The land capability classification of the Beemont and Ramsey soils is VIIe. The woodland ordination symbol is 2R.

60F—Gatewood-Menfro complex, 20 to 35 percent slopes, bouldery. These steep soils are mostly on the lower dissected side slopes in the uplands. In some areas they occupy entire side slopes between ridgetops and drainageways. Sandstone rock fragments, 2 feet or more in diameter, cover 0.01 to 0.1 percent of the surface. The moderately deep, moderately well drained Gatewood soil is on the lower south- and west-facing side slopes. The very deep, well drained Menfro soil is on the upper north- and east-facing side slopes and in interfluves. Individual areas of this unit are elongated and range from about 10 to several hundred acres in size. They are about 55 percent Gatewood soil and 40 percent Menfro soil.

The typical sequence, depth, and composition of the layers of the Gatewood soil are as follows—

Surface layer:
0 to 3 inches, dark grayish brown, friable gravelly silt loam

Subsurface layer:
3 to 9 inches, yellowish brown, friable gravelly silt loam

Subsoil:
9 to 15 inches, strong brown, firm gravelly clay
15 to 23 inches, strong brown, firm clay

Bedrock:
23 inches, fractured dolomite that has subsoil material between cracks and fractures in the upper 7 inches

In places the depth to bedrock is more than 40 inches. In some areas the surface layer is silt loam.

Important properties of the Gatewood soil—

Permeability: Slow
Surface runoff: Very rapid

Figure 13.—A typical area of prime farmland on a narrow flood plain along the Gasconade River. This land is in an area of the Nolin-Racoon-Pope association.

Available water capacity: Low
Organic matter content: Moderately low
Depth to bedrock: 20 to 40 inches
Seasonal high water table: Perched at a depth of 1.5 to 3.0 feet
Shrink-swell potential: High

The typical sequence, depth, and composition of the layers of the Menfro soil are as follows—

Surface layer:
- 0 to 3 inches, very dark grayish brown, friable silt loam

Subsoil:
- 3 to 9 inches, dark brown, firm silt loam
- 9 to 16 inches, dark yellowish brown, firm silty clay loam
- 16 to 25 inches, dark yellowish brown, mottled, firm silty clay loam
- 25 to 60 inches, dark yellowish brown, mottled, firm silt loam

Important properties of the Menfro soil—

Permeability: Moderate
Surface runoff: Very rapid
Available water capacity: High
Organic matter content: Moderately low
Shrink-swell potential: Moderate

Included with these soils in mapping are small areas of the very shallow and shallow Gasconade soils, mostly on south- and west-facing side slopes. Included soils make up about 5 percent of the map unit.

Most areas of the Gatewood and Menfro soils support native woodland and are used for timber production and as habitat for woodland wildlife. The Menfro soil has properties suitable for pasture or hayland, but it occurs in areas that are too segmented for these uses. The major soils in this unit are best suited to trees. Many existing stands could benefit from selective cutting and stand improvement. The hazard of erosion and the equipment limitation are management

concerns. Establishing roads and skid trails on the contour helps to minimize the steepness and length of slopes and the concentration of water. In some places it may be necessary to yard the logs uphill to logging roads or skid trails. Seeding disturbed areas and constructing water bars across roads and trails may be necessary after harvesting is completed. Because of the slope and because of the rock fragments in the surface layer of the Gatewood soil, it may be necessary to plant seedlings by hand or direct seeding.

The Menfro soil is suitable for building site development and onsite waste disposal systems if sites are carefully selected and proper design and installation procedures are used. The Gatewood soil is generally unsuitable for these uses because of the moderate depth to bedrock. Building sites on the Menfro soil should be selected in places where areas downslope from the sites are suitable for septic tank absorption fields or lagoons. The slope should be considered when septic tank absorption fields are designed, or the sewage can be piped to adjacent areas that are more suitable for lagoons. In areas of the Menfro soil, constructing basement walls, foundations, and footings of small commercial buildings and dwellings with adequately reinforced concrete helps to prevent the structural damage caused by shrinking and swelling of the subsoil. Land shaping can modify the slope, or the dwellings can be designed so that they conform to the natural contour of the landscape.

Low strength, the shrink-swell potential, the slope, and the potential for frost action are limitations on sites for local roads and streets. The depth to bedrock is an additional limitation in areas of the Gatewood soil. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. Some cut and fill may be necessary because of the slope, or the roads can be designed so that they conform to the natural contour of the landscape. Constructing roadside ditches and installing culverts for drainage can minimize the damage caused by shrinking and swelling and by frost action. Blasting may be needed to remove the bedrock in some areas of the Gatewood soil, or subgrade material can be hauled in from other areas.

The land capability classification is VIIe for the Gatewood soil and VIe for the Menfro soil. The woodland ordination symbol is 2R for the Gatewood soil and 3R for the Menfro soil.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

About 60,980 acres in the survey area, or nearly 18 percent of the total acreage, meets the soil requirements for prime farmland. This land is mainly on the flood plains (fig. 13) and on broad uplands in associations 4, 5, and 6, which are described under the heading "General Soil Map Units." Most of the prime farmland is used for cultivated crops, mainly corn and soybeans.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table and all soils that are frequently flooded during the growing season qualify as prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective

measures. The naturally wet soils in Gasconade County generally have been adequately drained, either through the application of drainage measures or through the incidental drainage that results from farming or other kinds of land development.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Natural Resources Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

In 1987, approximately 96,457 acres in Gasconade County, or about 46 percent of the farmland, was used as pasture (U.S. Department of Commerce, 1989). About 79,202 acres was used as woodland, and an estimated 58,543 acres was used as cropland. Approximately 11,621 acres was used for house lots, ponds, roads, wasteland, or other uses.

Although field crops are not grown extensively in Gasconade County, they make up a significant part of the county's agricultural production. In 1987, corn was harvested on about 9,186 acres, soybeans on 4,963 acres, grain sorghum on 2,528 acres, and wheat on 2,161 acres. Small acreages of oats, barley, and rye were also grown.

Most of the corn and soybeans are grown on the flood plains. Many areas of the more droughty soils, primarily in the uplands, are used for grain sorghum, wheat, grass, or grass-legume pasture and hay.

The potential for increased crop production in Gasconade County is good. Production can be increased by applying the latest agricultural technology on all of the cropland in the county. This soil survey can facilitate the application of such technology. About 49,470 acres in the county is made up of level and nearly level soils that generally are suitable for intensive cultivation. An additional 86,310 acres is gently sloping and moderately sloping soils that are suitable for cultivated crops if erosion is controlled. Trees have been cleared from most of this acreage.

Accelerated erosion is a major problem on nearly all of the sloping cropland and overgrazed pastureland in Gasconade County. All soils that have slopes of more

than 2 percent are susceptible to damage from erosion.

Erosion results in the gradual loss of the surface layer and reduces productivity. Erosion is especially damaging on soils that have a clayey subsoil, which becomes mixed with the plow layer. The clayey material in the plow layer makes tillage and seedbed preparation difficult and hinders germination. Union, Glensted, Bucklick, and Hartville soils have a clayey subsoil. Erosion also reduces the productivity of soils in which the rooting depth is restricted by a fragipan or bedrock, such as Gasconade, Gatewood, Moko, Ramsey, Union, and Wilderness soils. Erosion on these soils effectively reduces the volume of soil material available to supply water and nutrients.

Erosion on farmland can result in the sedimentation of streams, lakes, ponds, and road ditches. Controlling erosion minimizes this pollution and improves the quality of water for municipal and recreational uses and for fish and wildlife (fig. 14). It also prolongs the useful life of ponds, lakes, and roadside ditches by reducing the amount of sediments that enter them.

Erosion-control practices provide a protective surface cover, help to control runoff, and increase the rate of water infiltration. A cropping system that keeps vegetative cover or crop residue on the surface can hold erosion losses to amounts that will not reduce the productive capacity of the soil. Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Including grasses and legumes in the crop rotation improves soil tilth, and the legumes provide nitrogen for the following crop.

Basic management techniques can minimize soil losses caused by erosion. Farming on the contour reduces the amount of soil lost by as much as 50 percent. A conservation tillage system is one in which at least 30 percent of the surface is covered with residue after the crop is planted. The crop residue controls erosion by reducing the impact of raindrops, which can dislodge unprotected topsoil, and by reducing the runoff rate. Larger amounts of residue on the surface increase the effectiveness of the system. All of the upland soils in the county that are commonly used for row crops are suitable for conservation tillage systems. No-till farming is a conservation tillage practice that eliminates tillage entirely and leaves nearly all of the crop residue on the surface. This system has proven to be an important element of the conservation efforts in the county. No-till farming also reduces equipment expense, minimizes surface compaction, saves time during planting season, conserves soil moisture, and reduces fuel costs.

The large amounts of residue left as a result of no-till farming reduce droughtiness by lowering the evaporation rate. This effect is an asset in the summer during droughty periods, but it tends to delay warming and drying of the soil in the spring. Therefore, no-till farming is best suited to very deep, moderately well drained or well drained soils, such as Bucklick, Menfro, Union, and Weingarten soils.

Contour stripcropping helps to control erosion by maintaining strips of permanent vegetation planted on the contour. The strips of grasses or legumes are commonly used for hay. The areas between the strips are cultivated, and row crops are planted on the contour. The grass or legume strips minimize erosion and help to filter the sediments from runoff that would otherwise leave the field.

Terraces help to control erosion by reducing the length of slopes. Broad-base terraces are most practical on uneroded upland soils that have smooth slopes of less than 8 percent. Because the construction of broad-base terraces actually increases the slope, however, further erosion-control measures are crucial if these terraces are used in the more sloping areas. In cultivated areas of the strongly sloping Menfro and Weingarten soils, productivity can be maintained by constructing narrow-base terraces or terraces that have grassed back slopes. In these terrace systems, cuts are made from the downslope side. On many soils, such as Glensted and Hartville soils, cuts made during the construction of terraces can expose the clayey subsoil. Topsoiling may be required in these areas. Similarly, Union soils require intensive management because the fragipan in the subsoil may be exposed if cuts are made.

Grade-stabilization structures create small bodies of water that eliminate gullied areas and minimize further uphill encroachment. These structures provide a stable place into which tile terrace outlets or grassed waterways can empty runoff from terraced fields.

As of 1991, the Conservation Reserve Program, which was part of the 1985 Food Security Act, has idled approximately 860 acres of land in Gasconade County that was formerly used for crops. Other set-aside programs have had a similar impact. The result is a significant effort in the prevention of soil loss.

Wetness and flooding are management concerns on about 46,720 acres in the county. They are concerns in areas of Auxvasse, Bremer, Dockery, Freeburg, Gladden, Haynie, Marion, Nolin, Pope, Racoon, and Waldron soils. They can delay planting or harvesting or can reduce crop production in most years. Flood-control measures are needed, and land grading or surface drainage helps to overcome the wetness. If flooding occurs, it is commonly during the period from November through May.

Soil fertility is naturally low in most of the eroded and shallow soils in the survey area, but additional plant

Figure 14.—Land use in the watershed determines the quality of water in the scenic Gasconade River.

nutrients are needed in all of the soils for maximum production. Most of the soils are naturally acid in the upper part of the root zone and require applications of lime to raise the pH and calcium levels sufficiently for the optimum growth of legumes. On all of the soils, additions of lime and fertilizer should be based on the results of soil tests, on the needs of the crop, and on the production level desired. The Cooperative Extension Service can help in determining these values.

Soil tilth affects seedbed preparation, root penetration and distribution, the germination of seeds, and water infiltration. Soils that have good tilth are granular and porous. Regular additions of organic material help to maintain good tilth.

Most of the cultivated soils in the county have a surface layer of silt loam or loam that has a low or moderate content of organic matter. If these soils are frequently cultivated, soil structure becomes weak and intense rainfall can cause the formation of a crust on the surface. The crust is hard when dry. It reduces the rate of water infiltration and increases the runoff rate. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration.

The nearly level Waldron and Bremer soils, which have a clayey surface layer, are commonly plowed in the fall so that tilth is improved for spring planting. Plowing these soils in the fall does not significantly

increase the risk of erosion. Plowing the more sloping upland soils in the fall, however, can result in severe erosion. Soil loss can be catastrophic when intense spring rains follow partial thawing of the bare, frozen surface layer.

A combination of different kinds of grasses and legumes is necessary to obtain maximum forage production for the climate in Gasconade County. Cool temperatures in the spring and fall are favorable for the production of cool-season grasses. The hot summer months are more favorable for the production of warm-season grasses. Many of the soils in the county are suited to both kinds of grasses, and some of the soils are suited to legumes. A management system that includes cool-season grasses, warm-season grasses, and legumes takes advantage of the entire growing season for forage production.

Tall fescue is the most common cool-season grass in Gasconade County. Limited acreages of orchardgrass, timothy, smooth bromegrass, reed canarygrass, and Kentucky bluegrass are also grown. Most of these grasses are commonly grown on upland soils, but reed canarygrass is planted primarily on the wetter sites on flood plains. These cool-season grasses can provide top production only when properly managed. Rotation grazing systems help to keep forage crops at an optimum height for the highest production. Supplemental fertilization and timely weed control also are essential for maximum production.

Cool-season grasses grow vigorously when temperatures are cool, between 50 and 85 degrees F. These grasses generally start growing in late March and can be grazed by late April. Timothy and bromegrass do not produce tillers unless a seedhead is allowed to develop. Therefore, overgrazing or haying too early in the growing season reduces the total production of these forage crops. Orchardgrass regrows vigorously with or without the development of a seedhead, so the timing of grazing or haying is less critical for this species than for timothy and bromegrass. Bluegrass is generally less productive than the other cool-season grasses, but it can better withstand overgrazing and poor management. Fescue can also withstand poor management and severe site conditions, but many stands of this grass are infested with endophytes and provide less than optimum weight gains, especially during the summer months. Existing stands can be reestablished with endophyte-free seed. Careful grazing management and interseeding of legumes can minimize the effects and reduce the spread of the infestation. Some stands of fescue are also not palatable to livestock. Reed canarygrass is moderately palatable and is highly productive in areas that are too wet for other grasses or row crops.

Because of the higher temperatures and the longer periods of daylight, the production of cool-season grasses decreases significantly by the middle of June. In the fall, the cooler temperatures and shorter days result in an increase in the growth of these plants. Production generally continues until the first killing frost, usually in late October. Tall fescue continues to grow until sometime in December.

Warm-season grasses that are commonly grown in Gasconade County include big bluestem, indiangrass, switchgrass, and little bluestem. These grasses were native in small areas because of their adaptation to the soils and climate of the county. They reach peak production during the hot summer months, when the temperature reaches 90 degrees F. Growth slows when temperatures fall below 70 degrees F. Warm-season grasses need only 40 percent as much water as cool-season grasses to produce the same amount of forage.

Strict management techniques are necessary for optimum production and longevity of warm-season grasses. Rotation grazing systems are needed so that the grasses can be utilized during periods of vigorous growth and so that overgrazing is prevented during dormant periods. Management should include prescribed burning and maintenance of minimum grazing heights. Warm-season grasses need fewer applications of supplemental fertilizer than cool-season grasses. Generally, nitrogen is the only supplement necessary for maximum production.

Legumes are included in many forage systems in Gasconade County. They improve overall forage quality and quantity. Including legumes with grasses in a seeding mixture stimulates growth of the grasses because of nitrogen fixation by bacteria on the roots of the legumes.

Pure legume stands provide sources of high protein forage. Some legumes, such as alfalfa and ladino clover, can cause bloating if unrestricted grazing is allowed; therefore, most pure legume stands are used for hay. Alfalfa is the legume most commonly used for hay production. Other legumes, such as red clover, birdsfoot trefoil, and ladino clover, are used in pasture mixes. Crownvetch is used to stabilize steep banks and critically eroding areas.

Use and management of legumes involve selecting soils that are compatible with the growth characteristics of the various plants. Most legumes require well drained or moderately well drained, very deep soils that have a high available water capacity. Nolin, Haynie, Menfro, Pope, and Weingarten soils are well suited to legumes. If pure stands of alfalfa are seeded, the hazard of accelerated erosion is severe. In sloping areas erosion-control measures, such as seeding in the fall and planting a nurse crop of oats, may be needed. Some

legumes, such as alsike clover, are tolerant of wet conditions.

Legumes do not need supplemental nitrogen because of the natural fixation that occurs in the root system. If they are used for hay, legumes commonly require large amounts of phosphorus and potassium. Since legumes do not grow well in areas of acid soils, heavy applications of limestone may be needed for optimum production on most soils. Soil testing is important.

The production of cool-season grasses, warm-season grasses, and legumes peaks at different periods of the growing season. Management plans that include all three kinds of forage make optimum use of the entire season. A system that rotates grazing or haying among these different crops increases production and maintains a permanent cover of vegetation, which protects the soil. On all of the soils in the survey area, timely mowing or chemical weed control helps to control competition from undesirable plants and encourages uniform grazing. Overgrazing reduces the production of grasses and legumes and increases weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

Specialty crops are grown on a limited basis in Gasconade County. In the area around Hermann, grapes are grown on the well drained Menfro soils for commercial wineries in the area. Some small areas are used as Christmas tree farms. These specialty crops require special equipment, management, and propagation techniques. This soil survey can help to identify areas that are suitable for these and other crops if specific soil-related requirements are known.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland or for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit (USDA, 1961). Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that

reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The capability classification of the map units in this survey area is given in the section "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

Douglas C. Wallace, forester, Natural Resources Conservation Service, helped prepare this section.

A forest is more than a group of trees. The trees, the soil, and associated plants and animals form a forest ecosystem that has many valuable properties. Wood fiber, sustained water quality and quantity, wildlife habitat, and recreational activities all are useful products from a productive forest ecosystem (Powers, 1985).

According to estimates by the Missouri Department of Conservation, about 47 percent of Gasconade County, or 156,457 acres, was forested in 1986 (Geissman and others, 1986). Forested uplands in Gasconade County are covered by oak-hickory and eastern redcedar communities. White oak, red oak, bitternut hickory, and black oak grow on the better sites. Post oak, blackjack oak, eastern redcedar, and hickories are dominant on the shallower and more droughty soils. Areas that are shallow to bedrock or are characterized by rock outcrop are dominated by eastern redcedar, blackjack oak, and prairie grasses. These areas are commonly referred to as glades or cedar breaks. Flood-plain sites commonly support black walnut, American elm, sycamore, bur oak, hackberry, green ash, and black willow. The variations in tree species and growth on both uplands and flood plains are dependent on the interaction of site characteristics, soil properties, and management activities.

Site characteristics that affect tree growth include aspect, slope, and topographic position. These site characteristics influence the amount of available sunlight, air drainage, soil temperature, soil moisture, and relative humidity. Generally, north and east aspects and the lower slope positions, which are cooler and have better moisture conditions, are the best upland sites for tree growth. Beemont, Union, and Coulstone soils are examples of soils that exhibit these favorable site characteristics.

Soil properties that affect the growth of trees include reaction (pH), fertility, drainage, texture, structure, and soil depth. The soil also serves as a reservoir for moisture, provides an anchor for roots, and supplies essential plant nutrients. Soils in which these properties are not extreme and that have an effective rooting depth of more than 40 inches provide the best medium for timber production.

Soil wetness is the result of a high water table, flooding, or ponding. It causes seedling mortality, limits the use of equipment, and increases the windthrow hazard by restricting the rooting depth of some trees. Soils that have a perched water table include Union, Freeburg, and Glensted soils. Ruts form easily if wheeled skidders are used when these soils are wet. Deep ruts tend to restrict lateral drainage, damage tree roots, and alter soil structure. Flooding is a problem on about 50,900 acres in the county. Included are areas of Auxvasse, Bremer, Cedargap, Dockery, Freeburg, Gladden, Haynie, Pope, Nolin, Racoon, Sarpy, and Waldron soils. On all of these flooded soils, equipment should be used only during dry periods or when the ground is frozen.

Slope can limit the use of forestry equipment. A slope of 15 percent or more limits the use of equipment in logging areas, on skid roads, in yarding areas, and on logging roads. Accelerated erosion is a hazard in these disturbed areas. The use of equipment is limited on about 110,700 acres in the survey area. This acreage is also susceptible to erosion. It includes many areas of Beemont, Coulstone, Gasconade, Gatewood, Menfro, and Weingarten soils. Using special erosion-control measures, such as water bars or dips, and designing logging roads and trails so that the steepness and length of slopes and the concentration of water are

minimized can reduce the hazard of erosion. Equipment should be operated on the contour when possible. In strongly sloping areas, it may be necessary to yard the logs uphill to skid trails and yarding areas.

The content of clay in a soil can affect equipment use and seedling mortality. Clayey soils have reduced traction, have a moderate or high seedling mortality rate, and can easily become compacted when wet. Ruts form easily on unsurfaced roads and skid trails. These trails may be impassable during rainy periods. Soils that have a high content of clay include Hartville, Waldron, and Beemont soils.

Soil depth is one of the most significant soil properties affecting woodland productivity. Soil depth allows a tree to anchor its roots and provides volume for available water and nutrients. Shallow soils have a limited rooting depth and rooting volume. Trees in areas of these soils are susceptible to water stress during dry years or dry seasons and are subject to windthrow during high winds. Gasconade soils are shallow soils that have bedrock within a depth of 20 inches. Because of a fragipan in the subsoil, the effective rooting depth of Wilderness soils is also less than 20 inches. Shallow soils and areas of rock outcrop not only restrict the use of equipment but also hinder the construction of logging roads. Careful planning is needed.

Management activities can influence woodland productivity and should be aimed at eliminating factors that cause tree stress. Generally, such management includes thinning overstocked young stands; harvesting old, mature trees; planting trees where natural regeneration is insufficient or undesirable; and preventing destructive fire and grazing by livestock.

Concentrating management activities on sites that have the most productive soils and in areas that support high-value timber species helps to maximize woodland productivity. The more productive soils in Gasconade County include Menfro and Coulstone soils in the uplands and Nolin, Pope, and Sarpy soils on flood plains. High-value timber species include white oak, red oak, black walnut, and black oak.

Fire and grazing have very negative impacts on forest growth and quality. About 22 percent of the woodland is still subject to moderate or heavy grazing. Grazing destroys the leaf layer on the surface, compacts the soil, and kills or damages tree seedlings. Forest damage caused by fires is a major concern throughout the Ozarks. Fire not only results in damage to trees but also affects soil and water quality and wildlife habitat (Missouri Department of Conservation, 1986). Woodland sites that have not been grazed or burned have the highest potential for optimum timber production, for wildlife habitat, and for recreational uses.

Tables 7 and 8 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed.

Table 7 lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *N*, snowpack. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and N.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment and season of use are not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet,

the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It generally is the most common species on the soil and is the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Table 8 provides information about operating woodland equipment on haul roads, log landings, and skid trails and in logging areas. It also lists the limitations affecting site preparation and planting. Limitations are given for the most limiting season. In this survey area, the most limiting season is generally spring or winter. On some soils, however, it is during any wet period, when saturated soil conditions limit trafficability on the finer textured soils.

In table 8, a rating of *slight* indicates that the use of conventional logging equipment is not restricted if normal logging methods are used. A rating of *moderate* indicates that the use of equipment is restricted because of one or more soil factors. A rating of *severe* indicates that the kind of equipment that can be used is seriously restricted.

Haul roads are access roads leading from primary or surfaced roads to the logging areas. The logging roads serve as transportation routes for wheeled logging equipment and logging trucks. Generally, they are unpaved. Some may be graveled.

Log landings are areas where logs are assembled for transportation. Wheeled equipment may be used more frequently in these areas than in any other areas affected by logging.

Skid trails and logging areas include areas where some or all of the trees are being cut. Generally, equipment traffic is least intensive in the logging areas. Skid trails, which generally are within the logging area, are trails over which the logs are dragged or hauled from the stump to a log landing.

Site preparation and planting are the mechanized operations used for reforestation. The potential for topsoil displacement or concentrated storm runoff is high during these activities.

Windbreaks and Environmental Plantings

Douglas C. Wallace, forester, Natural Resources Conservation Service, helped prepare this section.

Living plants play an important role in supporting our life and improving its condition. When properly used and maintained, plants provide positive solutions to problems in our contemporary environment. In Gasconade County, windbreaks and environmental plantings can be utilized throughout the landscape for a variety of engineering, climatological, and esthetic purposes.

Windbreaks can be grown successfully in most areas of Gasconade County. Some important considerations affecting the management of farmstead and field

Figure 15.—A scenic area along the Bourbeuse River in Gasconade County.

windbreaks are design and layout, species selection, site preparation, seedling handling, weed management, supplemental watering, and protection from diseases, insects, and livestock.

Farmstead windbreaks make the farmstead more comfortable, reduce energy costs, increase yields from gardens and fruit trees, enhance wildlife populations, buffer noises, and increase property values (Scholten, 1988).

Feedlot windbreaks can be used to protect livestock from wind and snow. Windbreaks significantly minimize calf losses, make feeding easier, and enable livestock to maintain better weight with less feed.

Farmstead and feedlot windbreaks are generally three or more rows deep and include at least two rows of coniferous trees. The windbreaks should be established on the windward side of the area to be protected and should be at right angles to the prevailing winds. Well designed farmstead and feedlot windbreaks are needed in Gasconade County, especially in the cleared, forested upland areas of the Glensted and Beemont-Union associations, which are described under the heading "General Soil Map Units."

Field windbreaks or shelterbelts protect field crops and areas of bare soil from the effects of strong winds. Field windbreaks minimize soil losses, increase crop yields, help to prevent the spread of weeds, and enhance wildlife populations (Brandle and others, 1988).

Environmental plantings can be used for beautification, as visual screens, and for control of acoustical and climatological problems around buildings and other living spaces. Plants whose height, shape, color, and texture are compatible with the surrounding area, structures, and desired use should be selected (Robinette, 1972). Trees and shrubs can be easily established in most parts of Gasconade County if proper site preparation methods are applied and weeds

and other competing vegetation are controlled.

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Reggie Bennett, area biologist, Missouri Department of Conservation, helped prepare this section.

Gasconade County has a rich diversity of plant and animal communities as well as a rich cultural heritage. Three major rivers, the Missouri, the Gasconade, and the Bourbeuse (fig. 15), offer many different kinds of recreational opportunities. Fishing, swimming, boating, floating, and wading are among the water activities available. There are six public access areas on the three rivers in the county—three on the Gasconade River, two on the Bourbeuse River, and one on the Missouri River (Missouri Department of Conservation, 1992). These areas range from 2 to 11 acres in size. The access on the Missouri River is in Hermann and is managed by the city of Hermann. There also are private canoe access areas in the county.

Canaan State Forest is the largest publicly owned recreational area in the county (Missouri Department of Conservation, 1988). The Missouri Department of Conservation manages the 1,400-acre State forest for timber production and as wildlife habitat. There are no lakes in this recreational area. Deer and turkey hunting is allowed under statewide regulations. The area also is known for its squirrel and rabbit hunting. Primitive camping is allowed in designated areas. Nuts, berries, and mushrooms may be collected for personal use.

The Mint Spring Natural Area, which has several unique natural features, is also available to the public. This area has no lakes. The same hunting regulations apply as those in the Canaan State Forest.

A camping and recreational vehicle park is in Hermann. The county also has archery and shooting ranges, city parks, swimming pools, and golf courses (National Association of Conservation Districts). Several State historic sites are located in the county. These include historic houses; petroglyphs; the Missouri River Dredge Site, in the town of Gasconade; and the Deutschheim Historic Area in Hermann. The county also offers beautiful spring and fall colors as the seasons change.

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites (fig. 16), and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive

Figure 16.—This pit in an area where refractory clay deposits have been mined has been allowed to fill with water and is used as wildlife habitat or for recreation.

foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Reggie Bennett, area biologist, Missouri Department of Conservation, helped prepare this section.

Gasconade County is one of 13 counties in Missouri that make up the Northern and Eastern Ozark Border Zoogeographic Region (Nagel, 1970). Gasconade County has three distinct cover types—woodland, grassland, and cropland. Woodland makes up the largest acreage; less than 12 percent of the county is cropland. These three cover types also form the predominant wildlife habitat types. The diversity and types of wildlife depend on the diversity and types of vegetative cover and on the patterns in which the different types of cover are interspersed. Many areas of grassland and woodland are intermixed, thus creating a

tremendous amount of "edge" habitat. Edge habitat is a transition zone between different vegetation types, such as the zone between woodland and grassland.

It is generally assumed that much of the Ozarks and the surrounding area, which includes Gasconade County, was wooded prior to settlement (Schroeder, 1982). It is also possible, however, that much of the Ozarks was not predominantly wooded but rather was a mixture of grasses and trees, known as savannahs or parks, and that prairie grasses and forbs were dominant but were intermixed with scattered oaks (Beilmann and Brenner, 1951). The change in vegetation toward more woodland cover may be the result of fewer fires since the area was settled and a general trend of increased precipitation. Regardless of the vegetative patterns prior to settlement, Gasconade County has great potential for wildlife habitat.

About 198 fish and wildlife species have been recorded in Gasconade County, and an additional 31 species are likely in the area. Some species, such as ospreys, are only very rarely found. Many species of wildlife migrate through the area in the spring and fall, including blue-winged teal and Canada geese, and resident flocks of Canada geese also inhabit the area. Typical nongame species include the eastern bluebird, the common grackle, the American kestrel, and the pileated woodpecker. Some common game species include eastern wild turkey, white-tailed deer, flathead catfish, common snapping turtle, and raccoon.

The endangered bald eagle and peregrine falcon have been sighted in the county. Several species on Missouri's rare and endangered species list have been reported in the county, including sicklefin chub, cooper's hawk, least weasel, and pink mucket pearly mussel. Other rare or endangered species are also likely to be found in the area. These include pallid sturgeon, four-toed salamander, snowy egret, and northern harrier.

The furbearer population in Gasconade County is good. The county has historically been among the top ten counties in the state for annual raccoon harvest. The population of bobcats increased slightly during the 1980's. Other species in the county include muskrat, opossum, coyote, beaver, and mink. River otters were released in an adjacent county and have migrated to Gasconade County.

The Weingarten-Gatewood-Gasconade association, the Glensted association, and the Menfro-Gatewood association, which are described under the heading "General Soil Map Units," have more than 50 percent grass cover type. A smaller acreage in these associations is used as cropland. The Weingarten-Gatewood-Gasconade and Menfro-Gatewood associations also have substantial acreages of woodland. Abandoned fields are readily invaded by redcedar and other woody species. The Weingarten-Gatewood-Gasconade association has dolomite glades, and the Coulstone-Union association has sandstone glades. These glades could benefit from prairie/savannah restoration efforts. A unique feature of the Menfro-Gatewood association is the St. Peter sandstone bluffs near Hermann. Stands of the rare wild sarsaparilla grow on these cliffs. Management for this cover type and for the associated wildlife includes maintaining a forest buffer adjacent to the sandstone cliffs, especially on north aspects.

Grassland cover makes up the second most extensive habitat type in the county. It occurs in areas of the Weingarten-Gatewood-Gasconade, Glensted, Menfro-Gatewood, Beemont-Union, Beemont-Weingarten, and Coulstone-Union associations. The main grass species is fescue, however, which is being managed poorly in terms of wildlife habitat. Using a rotation grazing system and including legumes and different species of grass, such as orchardgrass, can improve the habitat in these areas. Reintroducing native warm-season grasses would also improve the quality of the habitat. Where remnants of the native warm-season grasses and native forbs exist, restoration of these natural plant communities is preferable to reintroduction. Restoration may include the use of prescribed burning and the removal of eastern redcedar.

A unique habitat type in the Glensted association and the Beemont-Union association is found in the numerous clay pits that are scattered throughout these areas. These pits can be managed for amphibians, which require fishless ponds in forested areas in order to breed. Species include spotted salamander, ringed salamander, marbled salamander, central newt (a type of salamander), spring peeper, gray treefrog, and three or four other frogs, including the bullfrog.

The Nolin-Racoon-Pope association in areas of bottom land along the Gasconade and Bourbeuse Rivers and the Waldron-Haynie association in areas of bottom land along the Missouri River provide additional openland habitat. The cover in these areas largely consists of cultivated crops. Many soil conservation measures can enhance the habitat in these areas. Such measures include leaving some crops standing as food plots and using a system of conservation tillage. These two associations also provide riparian habitat along the streams and riverbanks. This habitat type is important to belted kingfishers, great horned owls, chestnut-sided warbler, wood ducks, and more than 90 other species in Gasconade County. Sightings of bald eagles and osprey are also likely in these areas.

The Nolin-Racoon-Pope and Waldron-Haynie associations also contain most of the remaining wetlands in the county, and small wetlands are in

drainageways in the other associations. Wetlands and marshes provide an important cover type for many species of wildlife, including bullfrogs, red-winged blackbird, green-winged teal, blue-winged teal, beaver, deer, and mink. Some excessively wet areas in the Glensted association also offer marsh type cover. Old oxbow lakes and some wooded wetlands are also in different areas in the county.

The Coulstone-Union association supports what is probably the best overall oak-hickory forest in the county. About 70 percent of this association is forested with a good mixture of red oak and white oak. These tree species are important to wildlife because of the different times the acorns mature. Red oak acorns take 2 years to mature, but white oak acorns grow and drop in the same year. This cycle helps to ensure a consistent acorn crop through the years.

More than 50 percent of the Beemont-Union and Beemont-Weingarten associations is woodland. The next largest land use in these associations is grassland, and a small percentage is cropland. Woodland acreage in these associations is increasing as crop and hay fields are abandoned. The most prevalent woody species invading these sites are eastern redcedar, sassafras, and post oak. Prior to settlement, some of the acreage in these associations probably was made up of savannahs or supported a mixture of grass, brush, and timber generally referred to as "barrens." Where remnant stands of the native prairie plants are identified, restoration efforts should be considered.

Woodland wildlife species include white-tailed deer, eastern wild turkey, fox squirrel, and gray squirrel. All of these species are hunted seasonally in the county. Other woodland species are barred owl, gray tree frog, northern cardinal, bluejay, and broad-winged hawk. There are more than 150 woodland wildlife species in the county. Two important elements in the management of habitat for woodland wildlife are preventing grazing of woodland and preserving old second-growth tree stands.

All of the associations in the county include areas of edge habitat. About 90 species of wildlife are associated with edge habitat in Gasconade County. These include American toad, five-lined skink, rose-breasted grosbeak, several warblers, eastern cottontail rabbit, and northern bobwhite quail. The goal in managing this type of habitat is to create an area rich in plant diversity with different vegetative heights and types. The quality of most of the edge habitat in Gasconade County is poor, mainly because of the vegetation, which in most areas is made up of a single species of grass, such as fescue. In some areas the edge consists of an abrupt change between areas of pasture, woodland, or cropland without a transition zone.

Proper management of edge habitat is important in enhancing the overall quality of wildlife habitat in the county. Because of the variety of land cover—barrens, prairies, and woodland—and the variety of different land uses, Gasconade County has good potential for improving the habitat for all kinds of wildlife.

More than 70 species of fish inhabit the waters of Gasconade County. Prime fishing is available in rivers, streams, and farm ponds. Approximately 75 small lakes and hundreds of ponds are in the county. Most are stocked with largemouth bass, channel catfish, and bluegill. The county has 173 miles of permanent flowing streams (Missouri Department of Natural Resources, 1986). Anglers fish for channel catfish, carp, drum, smallmouth bass, largemouth bass, rock bass, and other sunfish. Gigging of nongame fish, floating, power boating, and wading also are important recreational activities.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat

is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and soybeans.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be

considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils (fig. 17).

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect

Figure 17.—Low-water crossing structures span many frequently flooded areas in the county. Some are impassable during periods of peak flow.

trafficability after vegetation is established.

Sanitary Facilities

Table 13 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site

features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading.

Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and

diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, and sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts and sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

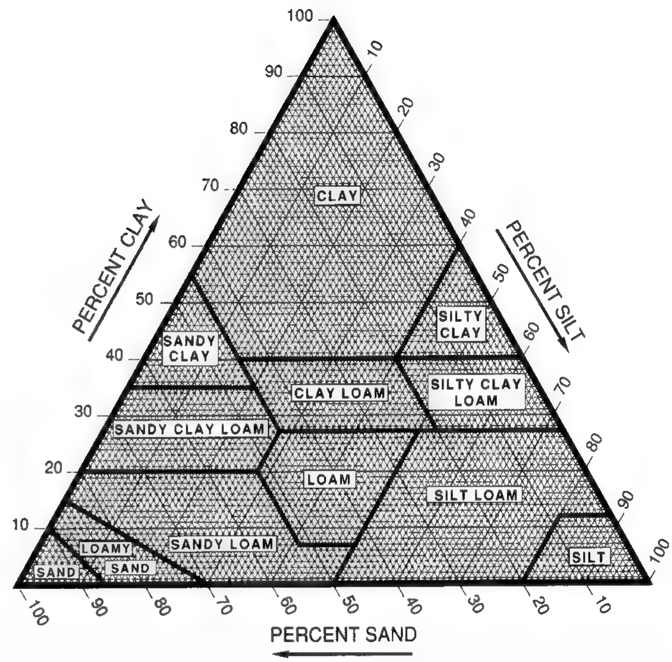


Figure 18.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 18). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and

highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for

fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 18, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2

to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 are depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18. Only saturated zones within a depth of about 6 feet are indicated.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (USDA, 1975). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 19 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol.* An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udalf (*Ud*, meaning humid, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Fragiudalfs (*Fragi*, meaning fragipan, plus *udalf*, the suborder of the Alfisols that has a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Fragiudalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, mixed, mesic Typic Fragiudalfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (USDA, 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 1975). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Auxvasse Series

The Auxvasse series consists of very deep, somewhat poorly drained soils on high flood plains. These soils formed in alluvium. Permeability is very slow. Slopes range from 0 to 3 percent.

These soils are classified as fine, montmorillonitic, mesic Aeric Albaqualfs.

Typical pedon of Auxvasse silt loam, 0 to 3 percent slopes, rarely flooded, 1,650 feet north and 1,250 feet east of the southwest corner of sec. 16, T. 44 N., R. 6 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; weak very fine granular structure; very friable; many very fine and few fine roots; slightly acid; clear smooth boundary.

EA—6 to 9 inches; grayish brown (10YR 5/2) silt loam; many fine faint dark brown (10YR 4/3) mottles; weak medium prismatic structure parting to weak fine granular; very friable; common very fine and few fine roots; common fine concretions of iron and manganese oxide; slightly acid; abrupt smooth boundary.

BE—9 to 11 inches; brown (10YR 5/3) silt loam; many fine faint grayish brown (10YR 5/2) mottles; weak very fine subangular blocky structure; friable; few fine and very fine roots; common fine concretions of iron and manganese oxide; moderately acid; abrupt smooth boundary.

Btg1—11 to 23 inches; grayish brown (2.5Y 5/2) silty clay; common fine distinct light olive brown (2.5Y 5/4) mottles; moderate fine angular blocky structure; firm; few fine and very fine roots; common distinct clay films on faces of peds; common fine concretions of iron and manganese oxide; moderately acid; clear smooth boundary.

Btg2—23 to 33 inches; light brownish gray (2.5Y 6/2) silty clay; few fine distinct light olive brown (2.5Y 5/4) mottles; moderate fine angular blocky structure; firm; few very fine and fine roots; common distinct clay films on faces of peds; common fine concretions of iron and manganese oxide; moderately acid; gradual smooth boundary.

Cg—33 to 60 inches; grayish brown (10YR 5/2) silty clay loam; many fine distinct grayish brown (2.5Y 5/2) and common fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; few very fine roots; many fine concretions of iron and manganese oxide; slightly acid.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The E, EA, or BE horizon has value of 5 or 6. The Btg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2.

Beemont Series

The Beemont series consists of very deep, moderately well drained soils on uplands. These soils formed in clayey residuum. Permeability is moderately rapid in the upper part and very slow in the lower part. Slopes range from about 5 to 35 percent.

These soils are classified as very fine, montmorillonitic, mesic Typic Hapludalfs.

Typical pedon of Beemont gravelly silt loam, 14 to 35 percent slopes, 2,500 feet west and 2,500 feet south of the northeast corner of sec. 1, T. 41 N., R. 6 W.

A—0 to 2 inches; dark brown (10YR 4/3) gravelly silt loam, pale brown (10YR 6/3) dry; moderate very fine granular structure; very friable; many very fine roots; about 15 percent chert gravel; strongly acid; abrupt smooth boundary.

E1—2 to 7 inches; light yellowish brown (10YR 6/4) gravelly silt loam; weak thin platy structure parting to moderate very fine granular; friable; common very fine roots; about 35 percent chert gravel; very strongly acid; clear smooth boundary.

E2—7 to 17 inches; light yellowish brown (10YR 6/4) gravelly loam; moderate very fine granular structure; friable; common very fine roots; about 35 percent chert gravel; very strongly acid; clear smooth boundary.

2Bt1—17 to 34 inches; strong brown (7.5YR 5/8) clay; weak very fine subangular blocky structure; firm; few faint clay films on faces of peds; few very fine roots; about 5 percent chert gravel; very strongly acid; clear smooth boundary.

2Bt2—34 to 46 inches; strong brown (7.5YR 5/8) and reddish yellow (5YR 6/8) clay; weak very fine subangular blocky structure; firm; few faint clay films on faces of peds; very strongly acid; clear smooth boundary.

2Cd—46 to 60 inches; strong brown (7.5YR 5/6) clay loam; massive; firm; about 50 percent fire clay fragments; very strongly acid.

The A horizon has value of 3 to 5 and chroma of 2 or 3. It is gravelly silt loam or gravelly loam. The E horizon has value of 4 to 6 and chroma of 2 to 4. It is the gravelly or very gravelly analogs of silt loam or loam. The 2Bt horizon has hue of 10YR to 2.5YR. The upper part has value of 4 to 6 and chroma of 3 to 8. The lower part includes chroma of 1. This horizon is silty clay loam, silty clay, clay, or the gravelly analogs of these textures.

Bremer Series

The Bremer series consists of very deep, poorly drained soils on high flood plains. These soils formed in alluvium. Permeability is moderately slow. Slopes range from 0 to 2 percent.

These soils are classified as fine, montmorillonitic, mesic Typic Argiaquolls.

Typical pedon of Bremer silty clay loam, rarely flooded, 2,550 feet west and 2,100 feet north of the southeast corner of sec. 12, T. 43 N., R. 6 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, gray (10YR 5/1) dry; moderate very fine granular structure; friable; many very fine roots; moderately acid; abrupt smooth boundary.

AB—8 to 15 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate very fine subangular blocky structure; firm; common very fine roots; slightly acid; gradual smooth boundary.

Btg1—15 to 36 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; few fine prominent yellowish brown (10YR 5/8) mottles; weak fine prismatic structure parting to moderate very fine subangular blocky; firm; common faint clay films on faces of peds; few black stains; few fine roots; slightly acid; gradual smooth boundary.

Btg2—36 to 51 inches; dark gray (10YR 4/1) silty clay loam; common fine faint very dark gray (10YR 3/1) and common fine prominent yellowish brown (10YR 5/8) mottles; weak fine prismatic structure parting to moderate very fine subangular blocky; firm; common prominent clay films on faces of peds; few black concretions; slightly acid; clear smooth boundary.

Btg3—51 to 60 inches; dark gray (10YR 4/1) silty clay; common fine prominent distinct yellowish brown (10YR 5/8) mottles; moderate very fine subangular blocky structure; firm; common faint clay films on faces of peds; about 5 percent chert gravel; slightly acid.

The A horizon has value of 2 or 3. The Btg horizon has value of 3 to 5 and chroma of 1 or 2.

Bucklick Series

The Bucklick series consists of deep, well drained soils on uplands. These soils formed in a thin layer of loess over clayey residuum and dolomite. Permeability is moderate. Slopes range from 5 to 14 percent.

These soils are classified as fine, mixed, mesic Typic Hapludalfs.

Typical pedon of Bucklick silt loam, 9 to 14 percent slopes, eroded, 1,900 feet south and 400 feet west of the northeast corner of sec. 7, T. 43 N., R. 5 W.

Ap—0 to 7 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate fine granular structure parting to weak very fine subangular blocky; friable; mixed with about 10 percent brown Bt material in the lower part; slightly acid; clear smooth boundary.

Bt1—7 to 17 inches; brown (7.5YR 4/4) silty clay; many fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm; common distinct clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—17 to 25 inches; brown (7.5YR 4/4) and reddish brown (5YR 4/4) silty clay; moderate medium subangular blocky structure; firm; common distinct clay films on faces of peds; few iron and manganese oxide stains; slightly acid; gradual smooth boundary.

Bt3—25 to 36 inches; brown (7.5YR 4/4) and reddish brown (5YR 4/4) silty clay; common fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; common distinct clay films on faces of peds; about 5 percent chert gravel; common iron and manganese oxide stains; moderately acid; gradual smooth boundary.

Bt4—36 to 48 inches; reddish brown (5YR 4/4) silty clay loam; many fine prominent strong brown (7.5YR 4/6) and many fine distinct brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; firm; common distinct clay films on faces of peds; about 5 percent chert gravel; many iron and manganese oxide stains; moderately acid; gradual smooth boundary.

2Bt5—48 to 54 inches; brown (7.5YR 4/4) very gravelly silty clay; many fine distinct reddish brown (5YR 4/4) and common fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm; common distinct clay films on faces of peds; about 50 percent chert gravel; slightly acid; abrupt smooth boundary.

2R—54 inches; dolomite.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has value of 4 or 5 and chroma of 4 to 8. It is silty clay loam or silty clay. The 2Bt horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. It is gravelly silty clay or very gravelly silty clay.

Cedargap Series

The Cedargap series consists of very deep, well drained soils on flood plains. These soils formed in alluvium. Permeability is moderate in the upper part and very slow in the lower part. Slopes range from 0 to 2 percent.

These soils are classified as loamy-skeletal, mixed, mesic Cumulic Hapludolls.

Typical pedon of Cedargap gravelly loam, frequently flooded, 650 feet north and 800 feet west of the southeast corner of sec. 9, T. 43 N., R. 6 W.

A1—0 to 10 inches; very dark grayish brown (10YR 3/2) gravelly loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; few fine and many very fine roots; about 30 percent chert gravel; moderately acid; clear smooth boundary.

A2—10 to 26 inches; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) extremely gravelly loam, brown (10YR 5/3) dry; weak very fine subangular blocky structure; friable; few fine and common very fine roots; about 85 percent chert gravel; slightly acid; gradual smooth boundary.

A3—26 to 44 inches; dark brown (10YR 3/3) and very dark gray (10YR 3/1) very gravelly loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; friable; about 35 percent chert and sandstone gravel; neutral; gradual smooth boundary.

C1—44 to 53 inches; dark yellowish brown (10YR 4/4) and brown (10YR 4/3) extremely gravelly loam; massive; firm; about 50 percent chert gravel and 25 percent chert and sandstone cobbles; neutral; gradual smooth boundary.

C2—53 to 60 inches; dark brown (10YR 3/3) extremely cobbly clay; massive; very firm; about 45 percent chert and sandstone gravel and 25 percent chert and sandstone cobbles; slightly acid.

The content of chert in the 10- to 40-inch zone averages 35 to 85 percent, by volume, and the content of clay averages 8 to 27 percent.

The C horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 1 to 4. It is the very gravelly, extremely gravelly, or extremely cobbly analogs of loam, silt loam, silty clay loam, clay loam, silty clay, or clay.

Coulstone Series

The Coulstone series consists of very deep, somewhat excessively drained soils on uplands. These soils formed in cherty residuum derived from sandstone and dolomite. Permeability is moderately rapid. Slopes range from 14 to 35 percent.

These soils are classified as loamy-skeletal, siliceous, mesic Typic Paleudults.

Typical pedon of Coulstone gravelly fine sandy loam, 14 to 35 percent slopes, 800 feet north and 1,250 feet west of the southeast corner of sec. 10, T. 40 N., R. 6 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) gravelly fine sandy loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; very friable; many fine roots; about 20 percent chert gravel; strongly acid; clear smooth boundary.

E1—3 to 16 inches; light yellowish brown (10YR 6/4) very gravelly fine sandy loam; weak thin platy structure parting to weak very fine granular; very friable; common fine roots; about 34 percent chert gravel; very strongly acid; gradual smooth boundary.

E2—16 to 30 inches; yellowish brown (10YR 5/4) extremely gravelly sandy loam; weak very fine granular structure; friable; common fine roots; about 65 percent chert and sandstone gravel and 10 percent sandstone cobbles; very strongly acid; gradual wavy boundary.

Bt1—30 to 37 inches; strong brown (7.5YR 5/6) very gravelly sandy loam; weak very fine subangular blocky structure; friable; few faint clay films on faces of peds; few fine roots; about 50 percent chert and sandstone gravel and 10 percent sandstone cobbles; very strongly acid; gradual wavy boundary.

Bt2—37 to 46 inches; yellowish red (5YR 5/6) very gravelly loam; weak very fine subangular blocky structure; friable; common faint clay films on faces of peds; about 40 percent chert and sandstone gravel and 5 percent sandstone cobbles; very strongly acid; gradual wavy boundary.

Bt3—46 to 60 inches; yellowish red (5YR 4/6) very gravelly loam; weak very fine subangular blocky structure; friable; common faint clay films on faces of peds; about 35 percent chert and sandstone gravel and 5 percent sandstone cobbles; very strongly acid.

The A horizon has value of 3 or 4 and chroma of 2 or 3. The E horizon has value of 4 to 6. It is the gravelly, very gravelly, or extremely gravelly analogs of fine sandy loam, loam, or sandy loam or is extremely cobbly sandy loam. The Bt horizon has value and chroma of 4 to 6.

Dockery Series

The Dockery series consists of very deep, somewhat poorly drained soils on flood plains. These soils formed in alluvium. Permeability is moderate. Slopes range from 0 to 2 percent.

These soils are classified as fine-silty, mixed, nonacid, mesic Aquic Udifluvents.

Typical pedon of Dockery silt loam, frequently flooded, 3,400 feet west and 500 feet south of the northeast corner of sec. 29, T. 45 N., R. 6 W.

Ap—0 to 6 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; moderate very fine granular structure; very friable; common very fine roots; slightly acid; abrupt smooth boundary.

C1—6 to 21 inches; dark brown (10YR 3/3) silt loam,

pale brown (10YR 6/3) dry; common fine faint dark grayish brown (10YR 4/2) mottles; massive; very friable; few thin discontinuous grayish brown (10YR 5/2) strata; few very fine roots; slightly acid; clear smooth boundary.

C2—21 to 31 inches; brown (10YR 4/3) silt loam; common fine faint dark grayish brown (10YR 4/2) mottles; massive; very friable; few thin discontinuous grayish brown (10YR 5/2) strata; slightly acid; clear smooth boundary.

C3—31 to 48 inches; brown (10YR 5/3) silt loam; common fine faint dark yellowish brown (10YR 4/4) mottles; massive; very friable; few thin discontinuous grayish brown (10YR 5/2) strata; few black iron and manganese oxide stains; moderately acid; clear smooth boundary.

C4—48 to 60 inches; grayish brown (10YR 5/2) and dark yellowish brown (10YR 4/4) silt loam; massive; very friable; strata of sand in the lower 2 inches; few black iron and manganese oxide stains; moderately acid.

The Ap or A horizon has value of 3 or 4 and chroma of 2 or 3. The C horizon has chroma of 1 to 3. It is silt loam or silty clay loam.

Freeburg Series

The Freeburg series consists of very deep, somewhat poorly drained soils on high flood plains. These soils formed in alluvium. Permeability is moderately slow. Slopes range from 0 to 3 percent.

These soils are classified as fine-silty, mixed, mesic Aquic Hapludalfs.

Typical pedon of Freeburg silt loam, 0 to 3 percent slopes, rarely flooded, 800 feet west and 2,300 feet south of the northeast corner of sec. 36, T. 44 N., R. 6 W.

Ap—0 to 11 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate very fine granular structure; very friable; many fine roots; slightly acid; abrupt smooth boundary.

E—11 to 19 inches; brown (10YR 5/3) silt loam; many fine distinct yellowish brown (10YR 5/6) and common fine faint dark grayish brown (10YR 4/2) mottles; weak medium platy structure parting to moderate fine granular; friable; common fine roots; slightly acid; clear smooth boundary.

Bt1—19 to 24 inches; brown (10YR 5/3) silty clay loam; common medium prominent yellowish brown (10YR 5/8) and few fine faint grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate very fine subangular blocky; firm; few faint clay films on faces of peds; common fine roots; strongly acid; clear smooth boundary.

Bt2—24 to 41 inches; brown (10YR 5/3) and yellowish brown (10YR 5/6) silty clay loam; common medium prominent dark grayish brown (10YR 4/2) mottles; moderate very fine subangular blocky structure; firm; few faint clay films on faces of peds and in old root channels; few fine roots; strongly acid; clear smooth boundary.

Bt3—41 to 48 inches; yellowish brown (10YR 5/6) silty clay loam; common medium prominent grayish brown (10YR 5/2) and few fine prominent dark grayish brown (10YR 4/2) mottles; weak very fine subangular blocky structure; firm; common distinct clay films in old root channels; strongly acid; clear smooth boundary.

Bt4—48 to 60 inches; yellowish brown (10YR 5/6) silty clay loam; common medium prominent grayish brown (10YR 5/2) and few fine prominent dark grayish brown (10YR 4/2) mottles; weak fine subangular blocky structure; firm; few distinct clay films in root channels and on faces of peds; few fine roots; moderately acid.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The E horizon has value of 5 or 6. The upper part of the Bt horizon has value of 4 or 5 and chroma of 3 to 6. The lower part has value of 4 to 6 and chroma of 2 to 6.

Gasconade Series

The Gasconade series consists of very shallow and shallow, somewhat excessively drained soils on uplands. These soils formed in clayey residuum. Permeability is moderately slow. Slopes range from 14 to 35 percent.

These soils are classified as clayey-skeletal, mixed, mesic Lithic Hapludolls.

Typical pedon of Gasconade gravelly clay loam, in an area of Gasconade-Rock outcrop complex, 14 to 35 percent slopes, 500 feet north and 1,400 feet west of the southeast corner of sec. 11, T. 42 N., R. 6 W.

A—0 to 2 inches; very dark brown (10YR 2/2) gravelly clay loam, very dark grayish brown (10YR 3/2) dry; weak very fine subangular blocky structure parting to weak fine granular; friable; about 25 percent chert gravel and 5 percent dolomite flagstones; many fine roots; slightly acid; clear wavy boundary.

Bw1—2 to 10 inches; very dark grayish brown (10YR 3/2) very gravelly clay, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; firm; about 50 percent chert gravel; common fine roots; neutral; clear wavy boundary.

Bw2—10 to 18 inches; dark yellowish brown (10YR 3/4)

extremely gravelly clay; moderate fine subangular blocky structure; very firm; about 50 percent chert gravel and 15 percent dolomite channers; few fine roots; neutral; abrupt wavy boundary.

R—18 inches; dolomite.

The depth to bedrock ranges from 8 to 20 inches.

The A horizon has value of 2 or 3 and chroma of 1 to 3. The Bw horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 to 4. It is the very gravelly, extremely gravelly, or very flaggy analogs of clay, silty clay, silty clay loam, or clay loam.

Gatewood Series

The Gatewood series consists of moderately deep, moderately well drained soils on uplands. These soils formed in clayey residuum over dolomite. Permeability is slow. Slopes range from 14 to 35 percent.

These soils are classified as very fine, mixed, mesic Typic Hapludalfs.

Typical pedon of Gatewood gravelly silt loam, 14 to 35 percent slopes, 1,650 feet east and 300 feet north of the southwest corner of sec. 13, T. 42 N., R. 6 W.

A—0 to 2 inches; very dark grayish brown (10YR 3/2) gravelly silt loam, light brownish gray (10YR 6/2) dry; moderate very fine granular structure; very friable; many medium and fine roots; about 10 percent chert gravel and 5 percent chert cobbles; slightly acid; clear smooth boundary.

E—2 to 10 inches; light yellowish brown (10YR 6/4) gravelly silt loam; weak thin platy structure parting to weak very fine granular; very friable; common medium and fine roots; about 34 percent chert gravel; strongly acid; abrupt smooth boundary.

2Bt1—10 to 14 inches; strong brown (7.5YR 5/6) clay; common fine distinct yellowish red (5YR 5/6) mottles; moderate very fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; about 10 percent chert gravel; very strongly acid; clear smooth boundary.

2Bt2—14 to 24 inches; strong brown (7.5YR 5/6) clay; common fine distinct yellowish brown (10YR 5/6) mottles; moderate very fine subangular blocky structure; very firm; few fine roots; common distinct clay films on faces of peds; common black iron and manganese oxide stains; neutral; clear smooth boundary.

2Bt3—24 to 30 inches; strong brown (7.5YR 5/6) clay; common fine distinct yellowish brown (10YR 5/6) and common fine prominent grayish brown (10YR 5/2) mottles; moderate very fine subangular blocky structure; very firm; few fine roots; common distinct clay films on faces of peds; common black iron and manganese oxide stains; neutral.

2R—30 inches; dolomite.

The A horizon has value of 3 or 4 and chroma of 1 to 3. The E horizon has value of 4 to 6 and chroma of 3 or 4. It is silt loam, loam, or the gravelly, very gravelly, or extremely gravelly analogs of these textures. The 2Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 8. It is silty clay or clay or the gravelly analogs of these textures.

Gladden Series

The Gladden series consists of very deep, well drained soils on flood plains. These soils formed in alluvium. Permeability is moderate in the upper part and moderately rapid in the lower part. Slopes range from 0 to 3 percent.

These soils are classified as coarse-loamy, siliceous, mesic Dystric Fluventic Eutrochrepts.

Typical pedon of Gladden loam, 0 to 3 percent slopes, frequently flooded, 850 feet north and 1,550 feet east of the southwest corner of sec. 31, T. 44 N., R. 4 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) loam, pale brown (10YR 6/3) dry; weak very fine granular structure; very friable; many very fine and fine roots; strongly acid; clear smooth boundary.

Bw1—9 to 23 inches; brown (10YR 4/3) loam; weak very fine granular structure; very friable; common dark brown (10YR 3/3) coatings on faces of peds; common very fine and few fine roots; slightly acid; clear smooth boundary.

Bw2—23 to 36 inches; brown (10YR 4/3) sandy loam; weak very fine granular structure; very friable; common very fine and few fine roots; about 5 percent chert gravel; slightly acid; clear wavy boundary.

C1—36 to 42 inches; dark yellowish brown (10YR 4/4) gravelly fine sandy loam; massive; very friable; few very fine roots; about 25 percent chert gravel; few fine iron and manganese oxide stains; slightly acid; clear wavy boundary.

2C2—42 to 60 inches; dark yellowish brown (10YR 4/4) extremely gravelly sandy loam; massive; very friable; about 60 percent chert gravel and 10 percent chert cobbles; common fine iron and manganese oxide stains; neutral.

The A horizon has value of 3 to 5 and chroma of 2 or 3. The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is loam, sandy loam, or the gravelly analogs of these textures. The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma

of 3 to 8. It is the gravelly, very gravelly, or extremely gravelly analogs of loam, fine sandy loam, or loamy sand.

Glensted Series

The Glensted series consists of very deep, poorly drained soils on uplands. These soils formed in loess and in the underlying limestone residuum. Permeability is slow. Slopes range from 1 to 5 percent.

These soils are classified as fine, montmorillonitic, mesic Mollic Albaqualfs.

Typical pedon of Glensted silt loam, 2 to 5 percent slopes, 1,950 feet north and 750 feet west of the southeast corner of sec. 4, T. 42 N., R. 5 W.

Ap—0 to 8 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate very fine granular structure; very friable; many fine roots; slightly acid; abrupt smooth boundary.

Btg1—8 to 19 inches; dark grayish brown (10YR 4/2) silty clay; common fine prominent red (2.5YR 4/6) mottles in the upper half, few fine faint very dark grayish brown (10YR 3/2) and common fine distinct dark yellowish brown (10YR 4/4) mottles in the lower half; moderate very fine subangular blocky structure; firm; common fine roots; common faint clay films on faces of peds; moderately acid; gradual smooth boundary.

2Btg2—19 to 29 inches; grayish brown (10YR 5/2) silty clay loam; many medium distinct dark yellowish brown (10YR 4/4) and few fine prominent dark brown (7.5YR 4/4) mottles; weak very fine subangular blocky structure; firm; common faint clay films on faces of peds; few fine round concretions of iron and manganese oxide; about 5 percent chert gravel; moderately acid; gradual smooth boundary.

2Btg3—29 to 39 inches; grayish brown (10YR 5/2) silty clay loam; many medium prominent yellowish brown (10YR 5/6) mottles; weak very fine subangular blocky structure; firm; few fine round concretions of iron and manganese oxide; about 5 percent chert gravel; few faint clay films on faces of peds; moderately acid; gradual smooth boundary.

2BCg—39 to 54 inches; grayish brown (10YR 5/2) silty clay loam; many medium prominent yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak very fine subangular blocky; firm; moderately acid; gradual smooth boundary.

2Cg—54 to 60 inches; grayish brown (10YR 5/2) silty clay; common medium prominent yellowish brown (10YR 5/6) mottles; massive; firm; moderately acid.

The Ap horizon has chroma of 2 or 3. Some pedons have an E horizon. The Btg horizon has value of 4 or 5 and chroma of 1 or 2. It is silty clay loam, silty clay, or clay. The 2BCg horizon has value of 4 or 5 and chroma of 1 or 2. It has mottles with value of 4 to 6 and chroma of 1 to 6. The 2Cg horizon has colors similar to those of the 2BCg horizon. It is silty clay, silty clay loam, or clay loam.

Hartville Series

The Hartville series consists of very deep, somewhat poorly drained soils on terraces. These soils formed in alluvium. Permeability is slow. Slopes range from 2 to 9 percent.

These soils are classified as fine, mixed, mesic Aquic Hapludalfs.

Typical pedon of Hartville silt loam, 2 to 5 percent slopes, 500 feet east and 450 feet south of the northwest corner of sec. 8, T. 44 N., R. 6 W.

Ap—0 to 9 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate very fine granular structure; very friable; common very fine roots; very strongly acid; abrupt smooth boundary.

B/A—9 to 13 inches; dark yellowish brown (10YR 4/4) silt loam; common fine prominent yellowish brown (10YR 5/8) mottles; pockets of dark brown (10YR 4/3) silt loam from the A horizon; weak very fine subangular blocky structure; friable; few very fine roots; very strongly acid; clear smooth boundary.

Bt1—13 to 20 inches; brown (10YR 5/3) silty clay loam; common fine distinct brown (7.5YR 4/4) and few fine faint dark grayish brown (10YR 4/2) mottles; moderate very fine subangular blocky structure; firm; few very fine roots; few faint clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt2—20 to 28 inches; brown (10YR 5/3) silty clay; common fine distinct brown (7.5YR 4/4) and few fine faint grayish brown (10YR 5/2) mottles; moderate very fine subangular blocky structure; firm; few distinct clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt3—28 to 42 inches; brown (10YR 5/3) silty clay; common fine faint grayish brown (10YR 5/2) and common fine faint dark yellowish brown (10YR 4/4) mottles; weak very fine subangular blocky structure; firm; few distinct clay films on faces of peds; strongly acid; clear smooth boundary.

Bt4—42 to 60 inches; grayish brown (10YR 5/2) silty clay; few fine faint dark brown (10YR 4/3) mottles; weak very fine subangular blocky structure; firm; few faint clay films on faces of peds; moderately acid.

The Ap horizon has value of 4 or 5 and chroma of 2 to 4. The E horizon, if it occurs, has value of 5 or 6 and chroma of 2 to 4. The upper part of the Bt horizon has value of 4 or 5 and chroma of 3 to 6. The lower part has chroma of 1 or 2. This horizon is silty clay loam, silty clay, or clay.

Haynie Series

The Haynie series consists of very deep, well drained soils on flood plains. These soils formed in alluvium. Permeability is moderate. Slopes range from 0 to 2 percent.

These soils are classified as coarse-silty, mixed (calcareous), mesic Mollic Udifluvents.

Typical pedon of Haynie very fine sandy loam, occasionally flooded, 1,600 feet east and 75 feet south of the northwest corner of sec. 5, T. 45 N., R. 6 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) very fine sandy loam, grayish brown (10YR 5/2) dry; moderate very fine granular structure; very friable; common fine roots; slight effervescence; slightly alkaline; abrupt smooth boundary.

C—9 to 60 inches; stratified yellowish brown (10YR 5/4) and brown (10YR 5/3) silt loam; common fine distinct reddish brown (5YR 4/4) mottles; massive; very friable; few iron and manganese oxide stains in the lower part; strong effervescence; moderately alkaline.

The C horizon typically has value of 4 or 5 and chroma of 2 to 4, but individual strata are more variable.

Marion Series

The Marion series consists of very deep, somewhat poorly drained soils on uplands. These soils formed in loess. Permeability is very slow. Slopes range from 0 to 2 percent.

These soils are classified as fine, montmorillonitic, mesic Albaquic Hapludalfs.

Typical pedon of Marion silt loam, 1,825 feet south and 475 feet east of the northwest corner of sec. 31, T. 42 N., R. 5 W.

Ap—0 to 8 inches; brown (10YR 5/3) silt loam, white (10YR 8/2) dry; weak very fine granular structure; very friable; common very fine roots; moderately acid; abrupt smooth boundary.

E—8 to 12 inches; pale brown (10YR 6/3) silt loam; weak thin platy structure; very friable; few very fine roots; very strongly acid; clear smooth boundary.

Bt—12 to 30 inches; yellowish brown (10YR 5/4) silty clay; few fine distinct grayish brown (10YR 5/2) mottles; moderate very fine subangular blocky structure; firm; common faint clay films on faces of peds; very strongly acid; clear smooth boundary.

Btg—30 to 41 inches; grayish brown (10YR 5/2) silty clay loam; many fine prominent strong brown (7.5YR 4/6) mottles; weak very fine subangular blocky structure; firm; few faint clay films on faces of peds; very strongly acid; clear smooth boundary.

Cg—41 to 60 inches; grayish brown (10YR 5/2) silty clay loam; many fine distinct yellowish brown (10YR 5/4) mottles; massive; friable; strongly acid.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The E horizon has value of 5 to 7 and chroma of 2 or 3. The Bt horizon has hue of 10YR or 2.5Y and chroma of 2 to 4. It is silty clay loam, silty clay, or clay. The Cg horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 or less. It is silt loam or silty clay loam.

Menfro Series

The Menfro series consists of very deep, well drained soils on uplands. These soils formed in loess. Permeability is moderate. Slopes range from 2 to 35 percent.

These soils are classified as fine-silty, mixed, mesic Typic Hapludalfs.

Typical pedon of Menfro silt loam, 5 to 9 percent slopes, 800 feet east and 500 feet south of the northwest corner of sec. 7, T. 45 N., R. 5 W.

Ap—0 to 7 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate very fine granular structure; very friable; common fine roots; slightly acid; abrupt smooth boundary.

B/A—7 to 12 inches; dark yellowish brown (10YR 4/4) silt loam; few dark brown (7.5YR 4/4) peds from the B horizon; moderate very fine subangular blocky structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

Bt1—12 to 25 inches; dark brown (7.5YR 4/4) silty clay loam; moderate medium prismatic structure parting to moderate very fine subangular blocky; firm; few very fine roots; common distinct clay films on faces of peds; few black stains; slightly acid; gradual smooth boundary.

Bt2—25 to 33 inches; dark brown (7.5YR 4/4) silty clay loam; weak medium prismatic structure parting to moderate very fine subangular blocky; firm; few very fine roots; common distinct clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt3—33 to 50 inches; dark brown (7.5YR 4/4) silty clay loam; weak medium prismatic structure parting to weak very fine subangular blocky; firm; few faint

clay films on faces of peds; slightly acid; gradual smooth boundary.

BC—50 to 60 inches; dark brown (7.5YR 4/4) silty clay loam; weak medium prismatic structure; friable; few faint clay films on faces of peds; slightly acid.

The A or Ap horizon has value of 3 or 4 and chroma of 2 to 4. The E horizon has value of 4 or 5 and chroma of 3 or 4. The Bt horizon has hue of 10YR or 7.5YR and chroma of 3 or 4. The C horizon, if it occurs, has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silt loam or silty clay loam.

Moko Series

The Moko series consists of very shallow, somewhat excessively drained soils on uplands. These soils formed in loamy limestone or dolomite residuum. Permeability is moderate. Slopes range from 5 to 14 percent.

These soils are classified as loamy-skeletal, mixed, mesic Lithic Hapludolls.

Typical pedon of Moko very flaggy silt loam, in an area of Bucklick-Beemont-Moko complex, 5 to 14 percent slopes, 1,000 feet north of the southwest corner of sec. 28, T. 43 N., R. 6 W.

A—0 to 1 inch; very dark grayish brown (10YR 3/2) very flaggy silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; common very fine roots; about 50 percent dolomite flagstones and channers; slightly alkaline; clear smooth boundary.

Bw—1 to 6 inches; very dark grayish brown (10YR 3/2) very flaggy silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; few fine and many very fine roots; about 30 percent channers and 20 percent flagstones; slightly alkaline; clear wavy boundary.

R—6 inches; dolomite.

The Bw horizon is silt loam, loam, or silty clay loam. It contains 35 to 60 percent coarse fragments consisting of flagstones, channers, or gravel.

Nolin Series

The Nolin series consists of very deep, well drained soils on flood plains. These soils formed in alluvium. Permeability is moderate. Slopes range from 0 to 2 percent.

These soils are classified as fine-silty, mixed, mesic Dystric Fluventic Eutrochrepts.

Typical pedon of Nolin silt loam, frequently flooded, 500 feet south and 1,500 feet west of the northeast corner of sec. 21, T. 44 N., R. 6 W.

Ap—0 to 9 inches; dark brown (10YR 4/3) silt loam, yellowish brown (10YR 5/4) dry; moderate very fine granular structure; very friable; many fine roots; neutral; abrupt smooth boundary.

Bw—9 to 36 inches; dark brown (10YR 4/3) silt loam; weak very fine subangular blocky structure parting to weak very fine granular; friable; common fine roots; slightly acid; clear smooth boundary.

C—36 to 60 inches; dark brown (10YR 4/3) silt loam; thin lens of dark yellowish brown (10YR 4/4) sandy loam at the top of the horizon; massive; friable; few fine roots; slightly acid.

The Bw horizon has chroma of 3 or 4. The C horizon has value of 4 or 5 and chroma of 3 or 4. It is silt loam, loam, or sandy loam.

Pope Series

The Pope series consists of very deep, well drained soils on flood plains. These soils formed in alluvium. Permeability is moderate. Slopes range from 0 to 2 percent.

These soils are classified as coarse-loamy, mixed, mesic Fluventic Dystrochrepts.

Typical pedon of Pope fine sandy loam, occasionally flooded, 3,200 feet north and 750 feet east of the southwest corner of sec. 22, T. 44 N., R. 6 W.

Ap—0 to 10 inches; brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; moderate very fine granular structure; very friable; common fine roots; strongly acid; abrupt smooth boundary.

Bw—10 to 34 inches; dark yellowish brown (10YR 4/4) loam; moderate very fine subangular blocky structure; very friable; few very fine roots; strongly acid; clear smooth boundary.

C—34 to 60 inches; dark yellowish brown (10YR 4/4) loam; massive; very friable; strongly acid.

The content of coarse fragments ranges from 0 to 15 percent throughout the solum.

The Ap horizon has chroma of 2 to 4. The B and C horizons have hue of 10YR or 7.5YR and chroma of 3 or 4. They are sandy loam, loam, or silt loam.

Racoon Series

The Racoon series consists of very deep, poorly drained soils on low terraces. These soils formed in alluvium. Permeability is slow. Slopes range from 0 to 3 percent.

These soils are classified as fine-silty, mixed, mesic Typic Ochraqualfs.

Typical pedon of Racoon silt loam, 0 to 3 percent slopes, rarely flooded, 600 feet south and 1,300 feet

east of the northwest corner of sec. 5, T. 44 N., R. 6 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, very pale brown (10YR 7/3) dry; weak very fine granular structure; very friable; common fine roots; very strongly acid; abrupt smooth boundary.

E1—9 to 20 inches; light gray (10YR 7/2) silt loam; many fine faint pale brown (10YR 6/3) mottles; weak medium platy structure; friable; few very fine roots; very strongly acid; clear smooth boundary.

E2—20 to 27 inches; light brownish gray (10YR 6/2) silt loam; common fine faint brown (10YR 5/3) mottles; weak medium platy structure; friable; common white (10YR 8/2) silt coatings; very strongly acid; abrupt smooth boundary.

Btg1—27 to 33 inches; grayish brown (10YR 5/2) silty clay loam; common fine faint brown (10YR 5/3) mottles; weak very fine and fine subangular blocky structure; firm; common faint clay films in root channels; common white (10YR 8/2) silt coatings; very strongly acid; clear smooth boundary.

Btg2—33 to 47 inches; grayish brown (10YR 5/2) silty clay loam; common fine faint light brownish gray (10YR 6/2) mottles; weak medium prismatic structure parting to weak very fine and fine subangular blocky; firm; common faint clay films in root channels; common black concretions and common pockets of white (10YR 8/2) silt; very strongly acid; clear smooth boundary.

Btg3—47 to 56 inches; grayish brown (10YR 5/2) silty clay loam; common fine faint light brownish gray (10YR 6/2) mottles; weak very fine and fine subangular blocky structure; firm; common faint clay films in root channels; common black iron and manganese concretions; very strongly acid; clear smooth boundary.

Btg4—56 to 60 inches; grayish brown (10YR 5/2) silty clay loam; weak very fine and fine subangular blocky structure; firm; few faint clay films in root channels; very strongly acid.

The Ap horizon has value of 4 to 6. The E horizon is 14 to 21 inches thick. It has value of 5 to 7 and chroma of 1 or 2. It has mottles with value of 4 to 7 and chroma of 1 to 3. The Btg horizon has value of 5 or 6 and chroma of 1 or 2.

Ramsey Series

The Ramsey series consists of shallow, somewhat excessively drained soils on uplands. These soils formed in loamy residuum over sandstone. Permeability is rapid. Slopes range from 14 to 35 percent.

These soils are classified as loamy, siliceous, mesic Lithic Dystrochrepts.

Typical pedon of Ramsey fine sandy loam, in an area of Beemont-Ramsey-Rock outcrop complex, 14 to 35 percent slopes, 1,600 feet north and 1,500 feet east of the southwest corner of sec. 1, T. 45 N., R. 5 W.

A1—0 to 1 inch; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; strong fine granular structure; very friable; many very fine, fine, and coarse roots; about 5 percent chert and sandstone cobbles; slightly acid; clear smooth boundary.

A2—1 to 5 inches; yellowish brown (10YR 5/4) fine sandy loam; moderate fine granular structure; friable; many very fine, fine, and coarse roots; about 5 percent chert and sandstone gravel and 5 percent chert and sandstone cobbles; strongly acid; clear smooth boundary.

Bw1—5 to 9 inches; yellowish brown (10YR 5/4) cobbly fine sandy loam; weak fine subangular blocky structure parting to weak fine granular; friable; many very fine, fine, and coarse roots; about 10 percent sandstone gravel and 20 percent sandstone cobbles; strongly acid; clear smooth boundary.

Bw2—9 to 13 inches; light yellowish brown (10YR 6/4) cobbly fine sandy loam; weak fine subangular blocky structure parting to weak fine granular; friable; common very fine, fine, and medium roots; about 5 percent sandstone gravel and 9 percent sandstone cobbles; strongly acid.

R—13 inches; sandstone.

The A horizon has value of 4 or 5 and chroma of 3 or 4. The Bw horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 8. It is fine sandy loam, loam, or the gravelly or cobbly analogs of these textures.

Sarpy Series

The Sarpy series consists of very deep, excessively drained soils on flood plains. These soils formed in alluvium. Permeability is rapid. Slopes range from 0 to 2 percent.

These soils are classified as mixed, mesic Typic Udipsamments.

Typical pedon of Sarpy fine sand, frequently flooded, 1,800 feet north and 100 feet west of the southeast corner of sec. 4, T. 45 N., R. 6 W.

A—0 to 4 inches; dark brown (10YR 4/3) fine sand, pale brown (10YR 6/3) dry; single grain; loose; few very fine roots; slightly alkaline; abrupt smooth boundary.

C1—4 to 26 inches; brown (10YR 5/3) fine sand; single grain; loose; moderately alkaline; clear smooth boundary.

C2—26 to 60 inches; brown (10YR 5/3) loamy fine sand; single grain; loose; common thin strata of dark brown (10YR 4/3) very fine sandy loam; moderately alkaline.

The A horizon has chroma of 2 or 3.

Union Series

The Union series consists of very deep, moderately well drained soils on uplands. These soils have a fragipan. They formed in a thin layer of loess over clayey residuum. Permeability is moderate above the fragipan and slow in the fragipan. Slopes range from 2 to 14 percent.

These soils are classified as fine, mixed, mesic Typic Fragiudalfs.

Typical pedon of Union silt loam, 5 to 9 percent slopes, 1,300 feet west and 750 feet north of the southeast corner of sec. 31, T. 43 N., R. 4 W.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; few fine and common very fine roots; slightly acid; clear smooth boundary.

BE—8 to 11 inches; yellowish brown (10YR 5/4) silty clay loam; moderate fine granular structure; friable; common very fine roots; slightly acid; clear smooth boundary.

Bt1—11 to 17 inches; strong brown (7.5YR 4/6) silty clay loam; moderate fine subangular blocky structure; firm; common very fine roots; common distinct clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—17 to 22 inches; dark yellowish brown (10YR 4/4) silty clay; common fine distinct dark brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; firm; common very fine roots; many prominent clay films and common distinct silt coatings on faces of peds; very strongly acid; clear smooth boundary.

Bt3—22 to 28 inches; dark yellowish brown (10YR 4/4) silty clay; many fine distinct grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; firm; few very fine roots; common prominent clay films on faces of peds; very strongly acid; clear smooth boundary.

2Btx1—28 to 37 inches; dark yellowish brown (10YR 4/4) silt loam; grayish brown (10YR 5/2) vertical streaks ½ inch wide on faces of 8-inch polygons; few prominent clay films within vertical streaks; weak very coarse prismatic structure with dense massive interiors; very firm; brittle; few very fine roots in vertical streaks; few prominent clay films on faces of peds; about 5 percent chert gravel; very strongly acid; gradual wavy boundary.

2Btx2—37 to 50 inches; brown (10YR 5/3) and light brownish gray (10YR 6/2) extremely gravelly silt loam; massive; very firm; brittle; few distinct clay films on faces of peds; about 75 percent chert gravel and 5 percent chert cobbles; very strongly acid; gradual wavy boundary.

3Bt—50 to 60 inches; brown (7.5YR 5/4) and red (2.5YR 4/8) clay; weak very fine subangular blocky structure; firm; common distinct clay films on faces of peds; about 10 percent chert gravel; moderately acid.

Depth to the fragipan ranges from 18 to 34 inches.

The A or Ap horizon has value of 3 to 5 and chroma of 2 or 3. The E horizon, if it occurs, typically has value of 4 to 6 and chroma of 3 or 4. The Bt horizon has value of 4 or 5 and chroma of 4 to 6. The 2Btx horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 6. It is silt loam, silty clay loam, or the gravelly, very gravelly, or extremely gravelly analogs of these textures. The 3Bt horizon has hue of 7.5YR to 2.5YR, value of 3 to 6, and chroma of 4 to 8. It is silty clay loam, silty clay, clay, or the gravelly or very gravelly analogs of these textures.

Waldron Series

The Waldron series consists of very deep, somewhat poorly drained soils on flood plains. These soils formed in alluvium. Permeability is slow in the upper part and moderate in the lower part. Slopes range from 0 to 2 percent.

These soils are classified as fine, montmorillonitic (calcareous), mesic Aeric Fluvaquents.

Typical pedon of Waldron silty clay, occasionally flooded, 1,500 feet north and 275 feet east of the southwest corner of sec. 6, T. 45 N., R. 6 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silty clay, grayish brown (10YR 5/2) dry; moderate very fine granular structure; firm; common fine roots; slightly acid; abrupt smooth boundary.

C1—9 to 55 inches; dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) silty clay with thin layers of silty clay loam; common fine faint brown (10YR 4/3) mottles; massive with many thin bedding planes; individual layers have moderate very fine subangular blocky structure; firm; common thin strata of brown (10YR 5/3) silt loam; common black iron and manganese concretions; common fine roots; slightly alkaline; clear smooth boundary.

C2—55 to 60 inches; stratified brown (10YR 5/3) and very dark grayish brown (10YR 3/2) silt loam and very fine sandy loam; massive; friable; few black

iron and manganese oxide stains; moderately alkaline.

The Ap horizon has chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y and chroma of 1 to 3.

Weingarten Series

The Weingarten series consists of very deep, moderately well drained soils on uplands. These soils formed in loess over dolomite residuum. Permeability is moderately slow. Slopes range from 5 to 35 percent.

These soils are classified as fine-silty, mixed, mesic Typic Hapludalfs.

Typical pedon of Weingarten silt loam, 5 to 9 percent slopes, 500 feet east and 1,200 feet south of the northwest corner of sec. 19, T. 44 N., R. 4 W.

Ap—0 to 7 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate very fine granular structure; very friable; many fine roots; moderately acid; abrupt smooth boundary.

Bt1—7 to 18 inches; brown (7.5YR 4/4) silty clay loam; moderate very fine subangular blocky structure; friable; common fine roots; few faint clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt2—18 to 27 inches; yellowish brown (10YR 5/4) silty clay loam; firm; common fine roots; common faint clay films on faces of peds; common faint gray silt coatings on faces of peds; very strongly acid; clear smooth boundary.

Bt3—27 to 33 inches; brown (10YR 5/3) silty clay loam; common medium distinct dark yellowish brown (10YR 4/6) and common medium prominent yellowish brown (10YR 5/8) mottles; moderate very fine subangular blocky structure; firm; few fine roots; common faint clay films on faces of peds; very strongly acid; clear smooth boundary.

Bx—33 to 53 inches; dark yellowish brown (10YR 4/4) silt loam; common medium faint yellowish brown (10YR 5/4) and common medium distinct grayish brown (10YR 5/2) mottles; moderate very fine subangular blocky structure; firm; about 30 percent of the matrix is brittle; few fine roots; few faint clay films on faces of peds; strongly acid; clear wavy boundary.

2Btb1—53 to 59 inches; yellowish brown (10YR 5/4) gravelly silty clay loam; moderate very fine subangular blocky structure; firm; few very fine roots; about 25 percent chert gravel and 5 percent chert and sandstone cobbles; strongly acid; clear wavy boundary.

2Btb2—59 to 65 inches; red (2.5YR 4/8) silty clay; few fine prominent yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; very firm; common distinct clay films on faces of peds; about 10 percent chert and sandstone gravel; moderately acid.

Depth to the 2Btb horizon ranges from 40 to 60 inches.

The Ap or A horizon has value of 4 or 5 and chroma of 3 or 4. Some pedons have an E horizon. This horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. The Bt horizon has chroma of 3 to 6. It is silt loam or silty clay loam. The Btx horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. The 2Btb horizon has chroma of 4 to 8. It is silty clay loam, silty clay, clay, or the gravelly or very gravelly analogs of these textures.

Wilderness Series

The Wilderness series consists of very deep, moderately well drained soils on uplands. These soils have a fragipan. They formed in cherty limestone residuum. Permeability is moderate above the fragipan and slow in the fragipan. Slopes range from 9 to 14 percent.

These soils are classified as loamy-skeletal, siliceous, mesic Typic Fragiudalfs.

Typical pedon of Wilderness gravelly silt loam, 9 to 14 percent slopes, 1,325 feet south and 1,100 feet west of the northeast corner of sec. 8, T. 41 N., R. 6 W.

A—0 to 4 inches; dark brown (10YR 3/3) gravelly silt loam; weak fine and very fine subangular blocky structure; very friable; many fine and few medium roots; about 20 percent chert gravel; slightly acid; clear smooth boundary.

E—4 to 17 inches; brown (10YR 5/3) very gravelly silt loam; weak thin platy structure parting to moderate fine granular; very friable; common medium and fine and few coarse roots; about 45 percent chert gravel and 5 percent chert cobbles; strongly acid; gradual wavy boundary.

Bt—17 to 27 inches; strong brown (7.5YR 4/6) extremely gravelly silt loam; weak fine subangular blocky structure; firm; common fine roots; common distinct clay films on faces of peds; about 80 percent chert gravel; strongly acid; gradual wavy boundary.

Btx—27 to 42 inches; yellowish brown (10YR 5/6) extremely gravelly silt loam; many fine distinct pale brown (10YR 6/3) and few fine distinct strong brown (7.5YR 4/6) mottles; weak fine subangular blocky structure; extremely firm; few fine roots, mainly in cracks; brittle; few faint clay films on faces of peds; about 90 percent chert and sandstone gravel;

strongly acid; gradual wavy boundary.

2Bt—42 to 60 inches; brown (7.5YR 5/3) and red (2.5YR 4/6) gravelly clay; common fine distinct strong brown (7.5YR 5/6) mottles; weak medium angular blocky structure; very firm; common distinct clay films on faces of peds; about 20 percent chert gravel; very strongly acid.

Depth to the fragipan ranges from 19 to 29 inches. The A horizon has value of 3 to 5 and chroma of 2 or 3. The E horizon has value of 4 or 5 and chroma of 3 or 4. The Bt horizon has hue of 10YR to 5YR, value of 4 or 5, and chroma of 4 to 6. It is the very gravelly or extremely gravelly analogs of silt loam or silty clay loam. The Btx horizon has hue of 10YR to 5YR, value of 4 to 7, and chroma of 1 to 6. It is extremely gravelly loam or extremely gravelly silt loam. The 2Bt horizon has hue of 7.5YR to 2.5YR, value of 3 to 5, and chroma of 3 to 6. It is clay, gravelly clay, or very gravelly clay.

Formation of the Soils

Soil is the product of soil-forming processes acting on accumulated or deposited geologic materials. The characteristics of the soil are determined by the type of parent material; the plant and animal life on and in the soil; the climate under which the soil-forming factors were active; topography, or lay of the land; and the length of time these forces have been active.

The parent material affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Plant and animal life are the active factors of soil formation. The climate determines the amount of water available for leaching and the amount of heat for physical and chemical changes. Together, climate and plant and animal life act on the parent material and slowly change it to a natural body that has genetically related horizons. Relief often modifies these other factors. Finally, time is required for changes in the parent material to result in the formation of a soil. Generally, a long time is required for the development of distinct soil horizons.

Parent Material

Parent material is the unconsolidated mass from which soil is formed. The formation or the deposition of this material is the first step in the development of a soil profile. The characteristics of the material determine the chemical and mineralogical composition of the soil. The parent materials in Gasconade County are residuum, or material weathered from bedrock; loess, or silty material deposited by the wind; and alluvium, or material deposited by water.

Most of the residuum in the county is derived from clays and the associated sandstone and clastic rocks of the Pennsylvanian System (Missouri Geological Survey, 1961). Other important sources are the sandstone and dolomite formations of the Ordovician System.

The youngest residual parent materials in the county are Pennsylvanian clays, sandstone, shale, and the associated chert of unknown origin. These materials lie unconformably on eroded surfaces of the Ordovician System, primarily Jefferson City dolomite. Filled sink deposits of refractory clays are common at the contact point of these systems. Many of these clay pits have been mined. Sandstone rimrock commonly is associated with these filled sinks. Beemont soils and the lower part of the solum of most areas of Union and Weingarten soils formed in deposits of clay or in material weathered from these rocks and the associated chert.

Most of the exposed dolomite in Gasconade County is from the Jefferson City Formation. The underlying Roubidoux Formation contains more chert and interbedded sandstone than the Jefferson City Formation and is less extensive. It occurs mainly in the western and south-central parts of the county. Gatewood and Gasconade soils formed mainly in the less cherty, argillaceous residuum of the Jefferson City Formation, and Coulstone and Wilderness soils formed in the cherty, loamy residuum derived from the Roubidoux Formation.

Ramsey soils are in the northern part of the county. They are associated with outcrop escarpments of the St. Peter Sandstone Formation.

It is probable that loess once covered all of the survey area. The loess was deposited during the most recent postglacial period. The sources of this material were the flood plains along the Missouri River and its tributaries. These areas consisted of valleys choked with sediment deposited by glacial meltwater and were nearly barren in the still frigid climate. Violent dust storms in these areas blanketed the landscape with deposits of varying thicknesses, which decreased with increasing distance from the source. Erosion removed the loess at widely varying rates. It apparently kept pace with the rate of deposition on the steep, sun-warmed south- and west-facing slopes, and these areas have been completely stripped of loess. In contrast, the areas on north- and east-facing slopes remained frozen longer and thus retained an appreciable amount of loess. The thickness of the loess on the more stable landforms ranges from about 20 inches to 10 feet.

Menfro and Marion soils formed in thick deposits of loess. The upper part of Bucklick, Weingarten, Union, and Glensted soils also formed in loess.

The pattern of loess distribution indicates that no

major alterations of landforms have occurred since the loess was deposited (Brown, 1981). Subsequent geologic erosion has had little effect on the landscape but has removed some surface material, mainly loess.

The soils on the flood plains in Gasconade County formed in alluvial deposits ranging in thickness from about 3 to more than 30 feet. These soils differ widely in texture and chemical composition as a result of differences in floodwater velocity and in the kinds of primary source material. The soils on the Missouri River flood plain, which have a vast watershed as the source of material, are rich in unweathered minerals. Waldron soils formed in clayey deposits in slack-water areas. Haynie soils, which are in the higher areas on bottom land, have loamy textures. Sarpy soils formed in sandy material deposited by swift currents, mainly along the edge of the river.

The soils on the smaller flood plains in the county, along the Gasconade and Bourbeuse Rivers and their tributaries, formed mainly in silty and loamy alluvium. The basal deposits commonly are gravel, and the soil particles or coarse fragments decrease in size toward the soil surface. A similar gradation occurs as the distance downstream increases. The gravelly Cedargap soils are in narrow upstream reaches, and the silty Nolin soils dominate the broader flood plains (fig. 19). The loamy Gladden soils are in areas between the Cedargap and Nolin soils. The relatively rapid accumulation of loess as a source material and a decrease in stream velocity are among the causes of this gradation pattern.

Climate

Climate has been an important factor in the formation of the soils in Gasconade County. It has a direct impact on geologic erosion, the kinds of plant and animal life, and the parent materials of the soils.

Soil formation was greatly influenced by the climatic changes that produced glaciation. Thousands of years of cold temperatures alternating with moderate temperatures apparently produced the glaciers that moved into northern Missouri (Buol and others, 1980). The advent of warmer weather patterns caused the glaciers to recede. Meltwaters made the atmosphere more humid and volatile. The unprotected bedload from the glacier was easily blown by relentless winds that were generated by the climate change. The windblown material was carried to the southeast, gradually depositing the loess mantle that now covers much of the county. The climate at that time was cool and moist, and the native vegetation was woodland. A subsequent period of significantly lower rainfall caused small prairies to develop. The present climate favors the encroachment of woodland vegetation into the prairies, but prior to settlement, wildfires played a crucial role in maintaining prairies by killing woody seedlings that were invading the grasslands and by stimulating the growth of fire-tolerant warm-season grasses.

In addition to influencing native vegetation, the climate has a direct physical influence on the soil. The present subhumid midcontinental climate has distinct temperature fluctuations and predictable rainfall distribution with the seasons. Cycles of freezing and thawing result in the gradual disintegration of exposed bedrock. Any crevice that is large enough for water to enter is subject to more fracturing when the water freezes. South-facing slopes are subject to more of these cycles because sunlight warms them for longer periods than the corresponding north-facing slopes.

Moisture deficits in the summer contribute to cracking, which is instrumental in the development of argillic horizons in the subsoil. Subsequent rainfall disperses clay-sized particles in the upper layers of the soil, which move down into the cracks along with the percolating water. As the water is absorbed into the dry soil along the cracks, the clay particles are left on the surface of the cracks, creating clay films that define the aggregation of the soil and gradually increase the content of clay. Eventually much of the clay leaves the surface layer and migrates into the subsoil by this mechanism. The degree and depth of this translocation are indicators of the age of the soil. Most of the upland soils in Gasconade County show evidence of this clay movement.

Surplus moisture in the spring and late fall creates zones of saturation in some soils and influences the color of the subsoil. In general, gray colors are indicative of wetness that has resulted in a reduction of iron in the soil. Conversely, brown or red colors are associated with oxidation in the soil and indicate free movement of water through the soil. Some soils, including those of the Bremer series, have a continuous water table within the soil profile. Other soils, such as Union soils, have noncontinuous zones of saturation that occur because of subsoil horizons that hold the water up temporarily (perched water table). Some soils that are saturated for long periods support indicator plant species, such as smartweed, various sedges, silver maple, or cottonwood. This saturation affects the suitability of a soil for some agricultural crops that are sensitive to wetness, such as alfalfa, and also the effective length of the growing season in areas where cultivation and seedbed preparation are delayed by the seasonal wetness.

The influence of the regional climate on soil formation is modified in many places by local conditions. For example, the Gasconade soils on south-

Figure 19.—The silty Nolin soils are typical alluvial soils along the Gasconade River. The upland soils in the background formed in loess and residuum.

and west-facing slopes formed under the influence of a microclimate that is warmer and less humid than that of the very deep Weingarten soils, which are common on north- and east-facing slopes.

Living Organisms

The living organisms that influence soil formation include plants, burrowing animals, worms, insects, bacteria, and fungi. Among the soil properties affected are the content of organic matter and nitrogen, reaction, color, structure, and porosity.

The composition of plant communities varies, depending on the climate, depth, fertility level, available water capacity, and drainage class of the soil. Indigenous organic matter at the surface of soils that formed under forest vegetation is derived mainly from leaves, twigs, and logs, which decompose at the surface. These materials tend to be acidic. The resulting forest soils have a thin, dark surface layer and commonly have a leached subsurface layer. Union soils are examples of soils that formed under these conditions.

In contrast, the natural organic matter at the surface of soils that formed under prairie grasses is derived mainly from the decay of grasses and annual and biennial forbs. These plants are very effective in the uptake of bases, have a greater proportion of root mass, and have a comparatively short lifespan, resulting in a surface layer that is darker, thicker, and less acid than in the soils that formed under forest vegetation.

The soils that formed under grasses in Gasconade County are not extensive. Because the rainfall was adequate for forest vegetation, prairie grasses were limited to areas that were too wet or too dry for trees. The wet Bremer and Waldron soils and grassy glades of Gasconade and Moko soils formed in such areas.

Worms, insects, burrowing animals, large animals, and humans all affect and disturb the soil. Earthworms can pass through their bodies as much as 15 tons of dry earth per acre each year. The digestive enzymes and grinding action contribute significantly to the mixing and aeration of the soil, the breakdown of mineral and organic matter, and the increased availability of plant nutrients. Other animals affect the soil primarily by the mechanical mixing they produce. Actinomycetes, bacteria, and fungi contribute significantly to the formation of soils. Under favorable conditions, they may make up as much as 2 tons of mass in the plow layer of each acre. These micro-organisms cause rotting of organic materials, improve tilth, and fix nitrogen in the soils. The population of soil organisms is directly related to the rate of decomposition of organic matter in the soil. Differences in vegetation influence the kinds and populations of organisms and their activity (Buckman and Brady, 1972; Buol and others, 1980).

Since the early days of settlement, human activities have affected soil formation. Some of these effects have been drastic. Removal of trees and intensive cultivation and overgrazing have resulted in severe erosion in many areas. All of the productive topsoil has been lost in some places. Much of the sloping cropland and some poorly managed pastures are still eroding at a rate in excess of what is considered tolerable for sustained production. Some prime farmland has been covered by urban and residential areas. In addition to displacing productive land, these urban areas increase the rate of runoff because of roofs, roads, parking lots, and other structures that prevent water infiltration. Poor siting and design of sewage systems and other waste disposal systems have degraded water quality in some areas. Responsible land use that respects future generations as well as present needs is crucial.

Relief

Relief refers to the general degree of variance in the surface of the earth, the changes in elevation, and the nature of the slopes between one elevation and another. It is an important factor in determining the pattern and distribution of soils on a landscape because of its influence on drainage, runoff, erosion, and microclimate.

Relief results from natural forces that create unevenness in the land surface. In Gasconade County the streams that carry runoff from the flanks of the Ozark uplift have incised through dolomite and sandstone bedrock, creating entrenched and meandering stream valleys. Smaller streams branch toward the uplands, dissecting the side slopes that intervene between long interconnected ridgetops.

The amount of water entering and passing through the soil depends upon the steepness and shape of the slope, the permeability of the soil material, and the amount and intensity of rainfall. In steep areas, runoff is rapid and very little water passes through the soil. Consequently, distinct horizons develop slowly. The removal of weathered products by geologic erosion may nearly equal the rate of accumulation on some sites. Gasconade, Moko, and Ramsey soils formed under these conditions. In gently sloping or nearly level upland areas, runoff is slow and most of the water passes through the soil. As a result, soils in these areas show maximum profile development. Because of runoff from adjacent hillsides, areas on foot slopes receive an extra increment of water in addition to direct rainfall.

Concave areas are generally wetter than other slopes because runoff water converges in these areas. The flow is concentrated, and thus the volume of runoff that passes over and through the soil is greater. Convex areas are drier because the divergent water-flow pattern disperses the water, resulting in a smaller volume going over and through the soil.

South-facing slopes receive more direct sunlight than other slopes, and thus the soils warm and dry more quickly. The direction a slope faces also influences the kind of native vegetation that grows. South-facing slopes also undergo more freezing and thawing cycles than north-facing slopes, which tend to stay frozen longer.

Time

The degree of profile development reflects the length of time the parent material has been in place and subjected to weathering processes. Young soils show very little profile development or horizon differentiation. Old soils show the effects of leaching and the movement of clay and have distinct horizons that are readily observable.

The youngest soils in Gasconade County are those that formed in alluvium. Dockery soils, for example, do not show any profile development. Alluvial material is added to the surface nearly every year. Auxvasse, Freeburg, Bremer, and Racoon soils are the oldest alluvial soils. They are on high flood plains and show a moderate degree of profile development.

The oldest soils in the survey area formed in cherty residuum on upland side slopes. Long periods of time

were necessary for the bedrock matrix to weather and for the cherty residuum to accumulate. Coulstone and Wilderness soils formed in these areas. Beemont soils are of similar age, but they formed in clayey material weathered from cherty materials mixed with material weathered from shale and some sandstone. The loess soils, such as Marion and Menfro soils, show distinct horizon development, but the translocation of clay has not progressed as deeply into the profile as in the older Coulstone soils.

Many areas reflect dual chronologies. In Bucklick, Glensted, Union, and Weingarten soils, the substratum is older and has strongly expressed horizons. This material is covered by younger loess, which has in turn developed horizons of its own.

References

American Association of State Highway and Transportation Officials (AASHTO). 1986. Standard specifications for highway materials and methods of sampling and testing. 14th edition, 2 vols.

American Society for Testing and Materials (ASTM). 1993. Standard classification of soils for engineering purposes. ASTM Standard D 2487.

Beilmann, A.P., and L.G. Brenner. 1951. The recent intrusion of forests in the Ozarks. Annals of the Missouri Botanical Garden, vol. 38.

Brandle, J.R., and others, editors. 1988. Windbreak technology.

Brown, Burton L. 1981. Soil survey of St. Francois County, Missouri. U.S. Department of Agriculture, Soil Conservation Service.

Buckman, H.O., and N.C. Brady. 1972. Nature and properties of soils. 7th edition.

Buol, S.W., and others. 1980. Soil genesis and classification.

Gasconade County Historical Society. 1979. Gasconade County history.

Geissman, N.F., and others. 1986. Distribution of forestland in Missouri. Transcripts of the Missouri Academy of Science 20: 5-14.

History of southeast Missouri. 1888.

Missouri Department of Conservation. 1986. Woodland protection and wildlife. Timber and Wildlife Benefits on Private Land, number 10.

Missouri Department of Conservation. 1988. Discover outdoor Missouri. Map.

Missouri Department of Conservation. 1992. Summary of special regulations for conservation department areas.

Missouri Department of Natural Resources. 1986. Missouri water atlas. Division of Geology and Land Survey.

Missouri Geological Survey. 1961. The stratigraphic succession in Missouri. Water Resources Division.

Nagel, Werner O., editor and compiler. 1970. Conservation contrasts. Missouri Department of Conservation.

National Association of Conservation Districts. NACD outdoor recreation inventory—Missouri. (Unpublished data available in field offices of the Natural Resources Conservation Service)

Powers, R.F. 1985. Soil as a fundamental resource.

Robinette, G.O. 1972. Plants, people, and environmental quality. U.S. Department of the Interior, National Park Service.

Scholten, H. 1988. Farmstead shelterbelts—Protection against wind and snow. University of Minnesota Publication CD-BU-0468.

Schroeder, Walter A. 1982. Presettlement prairie of Missouri. Missouri Department of Conservation, Natural History Series, no. 2.

United States Department of Agriculture. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210.

United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conservation Service, U.S. Department of Agriculture Handbook 436.

United States Department of Agriculture. 1993. Soil survey manual. U.S. Department of Agriculture Handbook 18.

United States Department of Commerce, Bureau of the Census. 1989. Census of agriculture.

United States Department of Commerce, Bureau of the Census. 1991. Profile report for the State of Missouri and selected counties. STF1, pp. 297 and 3017.

Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hillslopes. Back slopes in profile typically range from gently sloping to very steep and linear and descend to a foot slope. In terms of gradational process, back slopes are erosional forms produced mainly by mass wasting and running water.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on the contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Chert. A hard, dense or compact, dull to semivitreous, cryptocrystalline sedimentary rock consisting of cryptocrystalline silica with lesser amounts of microcrystalline or cryptocrystalline quartz and amorphous silica.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles 2 millimeters to 38 centimeters (15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants

throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, or clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true

soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time.

Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Karst (topography). The relief of an area underlain by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by the wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and

mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 drawbar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Side slope. The slope bounding a drainageway and lying between the drainageway and the adjacent interfluve (e.g., shoulder). It is generally linear along the slope width, and overland flow is parallel down the slope.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey the following slope classes are used:

Nearly level	0 to 2 percent
Nearly level and very gently sloping	0 to 3 percent
Very gently sloping	1 to 3 percent
Gently sloping	2 to 5 percent
Moderately sloping	5 to 9 percent
Strongly sloping	9 to 14 percent
Moderately steep	14 to 20 percent
Steep	20 to 35 percent
Very steep	more than 35 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). A layer of otherwise suitable soil material that is too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1962-88 at Freedom, Missouri)

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	40.0	18.3	29.2	70	-16	9	1.51	0.40	2.39	3	3.3
February----	46.1	23.1	34.6	74	-8	16	1.90	.75	2.87	4	6.3
March-------	58.3	33.1	45.7	86	8	95	3.15	1.61	4.49	6	1.7
April-------	69.9	44.1	57.0	90	22	237	3.85	1.89	5.53	7	.0
May---------	77.4	51.8	64.6	91	33	453	4.77	2.80	6.51	7	.0
June--------	85.5	60.9	73.2	97	43	696	4.04	1.42	6.21	6	.0
July--------	90.9	65.2	78.1	102	49	871	3.04	1.34	4.49	5	.0
August------	89.2	62.8	76.0	104	46	806	3.23	1.18	4.92	5	.0
September---	81.6	55.5	68.6	98	35	558	3.97	1.57	5.99	6	.0
October-----	70.5	44.2	57.4	90	22	267	3.64	1.62	5.35	6	.0
November----	56.8	34.6	45.7	80	10	33	3.21	1.26	4.83	6	1.2
December----	45.2	24.6	34.9	73	-6	30	2.93	1.09	4.45	5	3.0
Yearly:											
Average---	67.6	43.2	55.4	---	---	---	---	---	---	---	---
Extreme---	---	---	---	105	-16	---	---	---	---	---	---
Total-----	---	---	---	---	---	4,071	39.24	30.19	48.14	66	15.5

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1962-88 at Freedom, Missouri)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 10	Apr. 22	May 2
2 years in 10 later than--	Apr. 5	Apr. 17	Apr. 26
5 years in 10 later than--	Mar. 26	Apr. 8	Apr. 15
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 16	Oct. 4	Sept. 28
2 years in 10 earlier than--	Oct. 22	Oct. 10	Oct. 3
5 years in 10 earlier than--	Nov. 4	Oct. 22	Oct. 13

TABLE 3.--GROWING SEASON

(Recorded in the period 1962-88 at Freedom, Missouri)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	193	172	159
8 years in 10	203	181	166
5 years in 10	222	197	180
2 years in 10	243	214	195
1 year in 10	255	225	204

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
01B	Union silt loam, 2 to 5 percent slopes	9,700	2.9
01C	Union silt loam, 5 to 9 percent slopes	29,500	8.8
01C2	Union silt loam, 5 to 9 percent slopes, eroded	21,000	6.3
01D2	Union silt loam, 9 to 14 percent slopes, eroded	10,000	3.0
02F	Coulstone gravelly fine sandy loam, 14 to 35 percent slopes	12,100	3.6
03A	Racoon silt loam, 0 to 3 percent slopes, rarely flooded	6,600	2.0
04A	Freeburg silt loam, 0 to 3 percent slopes, rarely flooded	1,500	0.4
05B	Hartville silt loam, 2 to 5 percent slopes	6,600	2.0
05C	Hartville silt loam, 5 to 9 percent slopes	5,200	1.5
06C2	Bucklick silt loam, 5 to 9 percent slopes, eroded	1,700	0.5
06D2	Bucklick silt loam, 9 to 14 percent slopes, eroded	4,800	1.4
07B	Menfro silt loam, 2 to 5 percent slopes	760	0.2
07C	Menfro silt loam, 5 to 9 percent slopes	5,600	1.7
07E2	Menfro silt loam, 14 to 20 percent slopes, eroded	4,250	1.3
10F	Gasconade-Rock outcrop complex, 14 to 35 percent slopes	9,300	2.8
11	Dockery silt loam, frequently flooded	3,300	1.0
12	Bremer silty clay loam, rarely flooded	1,400	0.4
13A	Auxvasse silt loam, 0 to 3 percent slopes, rarely flooded	810	0.2
16	Waldron silty clay, occasionally flooded	970	0.3
17D	Wilderness gravelly silt loam, 9 to 14 percent slopes	2,300	0.7
19	Haynie very fine sandy loam, occasionally flooded	740	0.2
20	Sarpy fine sand, frequently flooded	433	0.1
23F	Weingarten-Gatewood complex, 20 to 35 percent slopes	5,800	1.7
24F	Gatewood gravelly silt loam, 14 to 35 percent slopes	17,100	5.1
26D	Beemont gravelly silt loam, 5 to 14 percent slopes	37,750	11.3
26F	Beemont gravelly silt loam, 14 to 35 percent slopes	46,000	13.7
28C	Weingarten silt loam, 5 to 9 percent slopes	11,800	3.5
28D2	Weingarten silt loam, 9 to 14 percent slopes, eroded	10,700	3.2
28E2	Weingarten silt loam, 14 to 20 percent slopes, eroded	2,050	0.6
31D	Bucklick-Beemont-Moko complex, 5 to 14 percent slopes	2,300	0.7
32	Pits, quarries	580	0.2
35A	Glensted silt loam, 1 to 2 percent slopes	2,750	0.8
35B	Glensted silt loam, 2 to 5 percent slopes	4,150	1.2
37	Marion silt loam	1,450	0.4
39	Nolin silt loam, frequently flooded	8,100	2.4
43	Cedargap gravelly loam, frequently flooded	5,200	1.5
45	Pope fine sandy loam, occasionally flooded	4,250	1.3
49A	Gladden loam, 0 to 3 percent slopes, frequently flooded	17,600	5.2
51F	Beemont-Ramsey-Rock outcrop complex, 14 to 35 percent slopes	4,600	1.4
60F	Gatewood-Menfro complex, 20 to 35 percent slopes, bouldery	9,500	2.8
	Water areas less than 40 acres in size	3,050	1.0
	Water areas more than 40 acres in size	2,207	0.7
	Total	335,500	100.0

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
01B	Union silt loam, 2 to 5 percent slopes
03A	Racoon silt loam, 0 to 3 percent slopes, rarely flooded (where drained)
04A	Freeburg silt loam, 0 to 3 percent slopes, rarely flooded
05B	Hartville silt loam, 2 to 5 percent slopes
07B	Menfro silt loam, 2 to 5 percent slopes
11	Dockery silt loam, frequently flooded (where protected from flooding or not frequently flooded during the growing season)
12	Bremer silty clay loam, rarely flooded (where drained)
13A	Auxvasse silt loam, 0 to 3 percent slopes, rarely flooded (where drained)
16	Waldron silty clay, occasionally flooded (where drained)
19	Haynie very fine sandy loam, occasionally flooded
35A	Glensted silt loam, 1 to 2 percent slopes (where drained)
35B	Glensted silt loam, 2 to 5 percent slopes (where drained)
37	Marion silt loam
39	Nolin silt loam, frequently flooded (where protected from flooding or not frequently flooded during the growing season)
45	Pope fine sandy loam, occasionally flooded
49A	Gladden loam, 0 to 3 percent slopes, frequently flooded (where protected from flooding or not frequently flooded during the growing season)

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Grain sorghum	Winter wheat	Orchard-grass-red clover hay	Tall fescue	Tall fescue-lespedeza	Switchgrass
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
01B------------- Union	IIe	86	77	36	3.2	4.8	6.4	7.0
01C------------- Union	IIIe	78	68	32	2.9	4.4	5.8	6.4
01C2------------ Union	IVe	73	64	29	2.7	4.0	5.4	5.8
01D2------------ Union	VIe	---	---	---	2.3	3.5	4.6	5.0
02F------------- Coulstone	VIIe	---	---	---	---	2.6	---	---
03A------------- Racoon	IIw	103	90	42	3.8	5.7	7.6	8.3
04A------------- Freeburg	IIw	124	109	51	4.6	5.9	7.8	8.5
05B------------- Hartville	IIe	92	80	37	3.4	5.1	6.8	7.4
05C------------- Hartville	IIIe	83	73	34	3.1	4.7	6.2	6.8
06C2------------ Bucklick	IIIe	78	68	32	2.9	4.3	5.8	6.2
06D2------------ Bucklick	IVe	67	59	27	2.5	3.8	5.0	5.5
07B------------- Menfro	IIe	108	94	44	4.0	6.0	8.0	8.7
07C------------- Menfro	IIIe	101	88	41	3.7	5.5	7.4	8.0
07E2------------ Menfro	IVe	74	65	30	2.8	4.2	5.6	6.1
10F:								
Gasconade-------	VIIe	---	---	---	---	2.0	---	---
Rock outcrop.								
11-------------- Dockery	IIIw	103	90	42	3.8	5.7	7.6	8.3
12-------------- Bremer	IIIw	113	99	46	4.2	6.3	8.4	9.1
13A------------- Auxvasse	IIIw	92	80	37	3.4	5.1	6.8	7.4

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Grain sorghum	Winter wheat	Orchard-grass-red clover hay	Tall fescue	Tall fescue-lespedeza	Switchgrass
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
16-------------- Waldron	IIw	86	76	33	3.2	4.8	6.4	7.0
17D------------- Wilderness	VIe	---	---	---	---	1.8	2.4	2.6
19-------------- Haynie	IIw	108	94	44	4.0	6.0	8.0	8.7
20-------------- Sarpy	IVw	---	---	15	1.0	1.5	2.0	2.2
23F:								
Weingarten-----	VIIe	---	---	---	---	4.0	3.0	3.2
Gatewood-------	VIIe	---	---	---	---	2.1	2.8	3.0
24F------------- Gatewood	VIIe	---	---	---	---	1.0	1.4	1.5
26D------------- Beemont	VIe	---	---	---	---	3.6	4.5	4.9
26F------------- Beemont	VIIe	---	---	---	---	2.3	3.0	3.3
28C------------- Weingarten	IIIe	76	66	31	2.8	4.2	5.6	6.1
28D2------------ Weingarten	IVe	60	50	25	2.2	3.3	4.4	4.8
28E2------------ Weingarten	VIe	---	---	22	2.0	3.0	4.0	4.4
31D:								
Bucklick-------	IVe	55	50	24	2.3	3.4	4.3	4.6
Beemont--------	VIe	---	---	---	2.0	3.2	4.1	4.4
Moko-----------	VIIs	---	---	---	---	2.5	3.5	4.0
32. Pits								
35A------------- Glensted	IIe	97	85	40	3.6	5.4	7.2	7.8
35B------------- Glensted	IIIe	92	81	38	3.3	5.1	6.8	7.4
37-------------- Marion	IIIw	90	80	37	3.4	5.1	6.8	7.4
39-------------- Nolin	IIw	92	80	37	3.4	5.1	6.8	7.4
43-------------- Cedargap	IIIw	54	47	22	2.0	3.0	4.0	4.4

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Grain sorghum	Winter wheat	Orchard-grass-red clover hay	Tall fescue	Tall fescue-lespedeza	Switchgrass
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
45-------------- Pope	IIw	75	65	31	2.8	4.2	5.6	6.1
49A------------- Gladden	IIw	75	65	31	3.0	4.4	5.2	5.7
51F:								
Beemont---------	VIIe	---	---	---	---	2.0	2.7	2.9
Ramsey----------	VIIe	---	---	---	---	1.0	1.4	1.5
Rock outcrop.								
60F:								
Gatewood--------	VIIe	---	---	---	---	2.1	2.8	3.0
Menfro----------	VIe	---	---	---	---	4.0	5.2	5.7

* Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils that have been assigned a woodland ordination symbol are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
01B, 01C, 01C2, 01D2 Union	3D	Slight	Slight	Slight	Moderate	White oak	50	38	Shortleaf pine, scarlet oak, northern red oak.
						Shortleaf pine	53	80	
						Northern red oak	---	---	
						Black oak	---	---	
02F Coulstone	3R	Slight	Moderate	Moderate	Slight	White oak	54	38	Shortleaf pine, white oak, black oak, scarlet oak.
						Black oak	58	58	
						Scarlet oak	60	60	
						Shortleaf pine	55	78	
03A Racoon	4W	Slight	Severe	Moderate	Severe	Pin oak	80	62	Baldcypress, pin oak, red maple.
						Post oak	80	62	
						Green ash	---	---	
						White oak	---	---	
04A Freeburg	3A	Slight	Slight	Slight	Slight	White oak	65	48	White oak, pin oak, green ash, black oak, pecan.
05B, 05C Hartville	3C	Slight	Slight	Severe	Severe	White oak	55	38	Shortleaf pine, yellow-poplar, pin oak.
						Shortleaf pine	60	88	
06C2, 06D2 Bucklick	3A	Slight	Slight	Slight	Slight	White oak	61	44	Northern red oak, white oak.
						Northern red oak	---	---	
						Black oak	---	---	
						Post oak	---	---	
07B, 07C Menfro	3A	Slight	Slight	Slight	Slight	White oak	59	42	White oak, northern red oak, black walnut.
						Northern red oak	81	63	
						Black oak	73	55	
						White ash	70	66	
						Sugar maple	68	42	
07E2 Menfro	3R	Moderate	Moderate	Slight	Slight	White oak	59	42	White oak, black walnut, northern red oak.
						Northern red oak	81	63	
						Black oak	73	55	
						White ash	70	66	
						Sugar maple	68	42	
10F: Gasconade	2R	Severe	Severe	Moderate	Severe	Chinkapin oak	40	26	Eastern redcedar.
						Eastern redcedar	27	28	
						Post oak	---	---	
						Blackjack oak	---	---	
Rock outcrop.									
11 Dockery	4W	Slight	Moderate	Slight	Slight	Pin oak	76	58	Pin oak, pecan, eastern cottonwood.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
12-------------- Bremer	2W	Slight	Severe	Moderate	Moderate	Silver maple--------	80	34	Silver maple, eastern cottonwood, American sycamore, hackberry, green ash, northern whitecedar.
						Eastern cottonwood--	90	103	
13A------------- Auxvasse	4W	Slight	Severe	Moderate	Severe	Pin oak-------------	76	58	Pin oak, white oak, green ash, eastern cottonwood, silver maple.
						Northern red oak----	---	---	
						Silver maple--------	---	---	
						Green ash-----------	---	---	
16-------------- Waldron	11C	Slight	Moderate	Severe	Slight	Eastern cottonwood--	112	162	Eastern cottonwood, pin oak, green ash, silver maple.
						Pin oak-------------	80	62	
17D------------- Wilderness	3D	Slight	Slight	Moderate	Moderate	White oak-----------	56	38	White oak, black oak, shortleaf pine.
						Black oak-----------	63	46	
						Northern red oak----	64	47	
19-------------- Haynie	11A	Slight	Slight	Slight	Slight	Eastern cottonwood--	107	147	Eastern cottonwood, black walnut.
						American sycamore---	110	157	
						Black walnut--------	---	---	
						Green ash-----------	---	---	
20-------------- Sarpy	3S	Slight	Slight	Severe	Slight	Silver maple--------	90	42	Eastern cottonwood, American sycamore.
						Eastern cottonwood--	95	116	
23F:									
Weingarten-----	4R	Moderate	Moderate	Moderate	Slight	Northern red oak----	70	52	Black oak, northern red oak.
						White oak-----------	66	48	
						Black oak-----------	---	---	
Gatewood--------	2R	Moderate	Moderate	Slight	Slight	White oak-----------	45	30	Eastern redcedar, shortleaf pine.
						Eastern redcedar----	40	43	
						Post oak------------	43	28	
						Black oak-----------	42	28	
24F------------- Gatewood	2R	Moderate	Moderate	Slight	Slight	White oak-----------	45	30	Eastern redcedar, shortleaf pine.
						Eastern redcedar----	40	43	
						Post oak------------	43	28	
						Black oak-----------	42	28	
26D------------- Beemont	2C	Slight	Slight	Moderate	Moderate	White oak-----------	48	32	Eastern redcedar, shortleaf pine, black oak.
						Eastern redcedar----	---	---	
						Post oak------------	---	---	
						Northern red oak----	61	44	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
26F Beemont	2R	Severe	Moderate	Moderate	Moderate	White oak	48	32	Eastern redcedar, shortleaf pine, black oak.
						Eastern redcedar	---	---	
						Post oak	---	---	
						Northern red oak	61	44	
28C, 28D2 Weingarten	4A	Slight	Slight	Slight	Slight	Northern red oak	70	52	Black oak, northern red oak.
						White oak	66	48	
						Black oak	---	---	
						Shortleaf pine	---	---	
28E2 Weingarten	4R	Moderate	Moderate	Moderate	Slight	Northern red oak	70	52	Black oak, northern red oak.
						White oak	66	48	
						Black oak	---	---	
						Shortleaf pine	---	---	
31D:									
Bucklick	3A	Slight	Slight	Slight	Slight	White oak	61	44	White oak, northern red oak.
						Northern red oak	---	---	
						Black oak	---	---	
						Sugar maple	---	---	
Beemont	2C	Slight	Slight	Moderate	Moderate	White oak	48	32	Eastern redcedar, shortleaf pine.
						Eastern redcedar	---	---	
						Post oak	---	---	
						Northern red oak	61	44	
Moko	2D	Slight	Moderate	Moderate	Severe	Eastern redcedar	25	26	Eastern redcedar.
37 Marion	2W	Slight	Severe	Moderate	Severe	White oak	50	34	Pin oak, green ash, eastern cottonwood.
						Post oak	---	---	
39 Nolin	8W	Slight	Moderate	Slight	Slight	Black walnut	90	65	Black walnut, white ash.
						White ash	102	---	
						American sycamore	---	---	
43 Cedargap	3F	Slight	Slight	Moderate	Slight	Black oak	66	48	Black oak, shortleaf pine.
						American sycamore	---	---	
						Black walnut	---	---	
						Cottonwood	---	---	
45 Pope	7A	Slight	Slight	Slight	Slight	White oak	80	62	Black walnut, white oak, northern red oak, white ash.
						American sycamore	---	---	
						Northern red oak	---	---	
						Bitternut hickory	---	---	
49A Gladden	4W	Slight	Moderate	Slight	Slight	White oak	75	57	Black walnut, white oak.
						American sycamore	85	88	
						Black walnut	---	---	
51F:									
Beemont	2R	Severe	Moderate	Moderate	Moderate	Post oak	35	20	Shortleaf pine.
						Northern red oak	39	26	
Ramsey	2R	Moderate	Moderate	Moderate	Severe	Northern red oak	50	34	Shortleaf pine.
						Shortleaf pine	50	68	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
51F: Rock outcrop.									
60F: Gatewood	2R	Moderate	Moderate	Slight	Slight	White oak	45	30	Eastern redcedar, shortleaf pine.
						Eastern redcedar	40	43	
						Post oak	43	28	
						Black oak	42	28	
Menfro	3R	Moderate	Moderate	Slight	Slight	White oak	59	42	White oak, black walnut, northern red oak.
						Northern red oak	81	63	
						Black oak	73	55	
						White ash	70	66	
						Sugar maple	68	42	

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 8.--EQUIPMENT LIMITATIONS FOR WOODLAND HARVESTING

(Only the soils that have been assigned a woodland ordination symbol are listed. Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means that the soil was not rated)

Soil name and map symbol	Limitations for-- Haul roads	Log landings	Skid trails and logging areas	Site preparation and planting	Most limiting season(s)
01B, 01C, 01C2, 01D2------------ Union	Moderate: low strength.	Moderate: low strength.	Slight------------	Slight------------	None.
02F-------------- Coulstone	Moderate: slope.	Severe: slope.	Moderate: slope.	Slight------------	None.
03A-------------- Racoon	Severe: low strength, wetness.	Severe: low strength, wetness.	Slight------------	Severe: wetness.	Spring*.
04A-------------- Freeburg	Severe: low strength.	Severe: low strength.	Slight------------	Slight------------	Spring*, winter**.
05B, 05C--------- Hartville	Severe: low strength.	Severe: low strength.	Slight------------	Slight------------	Spring*, winter**.
06C2, 06D2------- Bucklick	Severe: low strength.	Severe: low strength.	Slight------------	Slight------------	None.
07B, 07C--------- Menfro	Severe: low strength.	Severe: low strength.	Slight------------	Slight------------	None.
07E2------------- Menfro	Severe: low strength.	Severe: low strength.	Moderate: slope.	Moderate: slope.	None.
10F:					
Gasconade-------	Severe: depth to rock, low strength.	Severe: depth to rock, low strength, slope.	Moderate: rock outcrop, slope.	Moderate: slope, rock outcrop, depth to rock.	Spring*, winter**.
Rock outcrop.					
11--------------- Dockery	Severe: flooding, low strength.	Severe: flooding, low strength.	Moderate: flooding.	Moderate: flooding.	Spring*.
12--------------- Bremer	Severe: low strength.	Severe: low strength.	Slight------------	Slight------------	Spring*.
13A-------------- Auxvasse	Severe: low strength.	Severe: low strength.	Slight------------	Slight------------	Spring*, winter**.
16--------------- Waldron	Severe: low strength, too clayey.	Severe: low strength, too clayey.	Severe: too clayey.	Moderate: too clayey.	Spring*.
17D-------------- Wilderness	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Spring*.
19--------------- Haynie	Moderate: low strength, flooding.	Moderate: low strength, flooding.	Slight------------	Slight------------	Spring*.

See footnotes at end of table.

TABLE 8.--EQUIPMENT LIMITATIONS FOR WOODLAND HARVESTING--Continued

Soil name and map symbol	Limitations for-- Haul roads	Log landings	Skid trails and logging areas	Site preparation and planting	Most limiting season(s)
20----------------- Sarpy	Severe: flooding.	Severe: flooding.	Moderate: flooding, too sandy.	Moderate: flooding, too sandy.	Spring.
23F:					
Weingarten-------	Severe: low strength.	Severe: low strength, slope.	Moderate: slope.	Moderate: slope.	Spring*, winter**.
Gatewood---------	Severe: low strength.	Severe: low strength, slope.	Moderate: slope.	Moderate: slope.	Spring*, winter**.
24F--------------- Gatewood	Severe: low strength.	Severe: low strength, slope.	Moderate: slope.	Moderate: slope.	Spring*, winter**.
26D--------------- Beemont	Severe: low strength.	Severe: low strength.	Slight------------	Slight------------	Spring*.
26F--------------- Beemont	Severe: low strength.	Severe: low strength, slope.	Moderate: slope.	Moderate: slope.	Spring*.
28C, 28D2--------- Weingarten	Severe: low strength.	Severe: low strength.	Slight------------	Slight------------	Spring*.
28E2-------------- Weingarten	Severe: low strength.	Severe: low strength, slope.	Moderate: slope.	Moderate: slope.	Spring*, winter**.
31D:					
Bucklick---------	Severe: low strength.	Severe: low strength.	Moderate: slope.	Moderate: slope.	Spring.
Beemont----------	Severe: low strength.	Severe: low strength.	Slight------------	Slight------------	Spring*.
Moko-------------	Severe: depth to rock.	Severe: depth to rock.	Moderate: slope.	Severe: depth to rock.	Spring*.
37---------------- Marion	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness.	Severe: wetness.	Spring*.
39---------------- Nolin	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: flooding.	Spring*.
43---------------- Cedargap	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: flooding.	Spring.
45---------------- Pope	Moderate: flooding.	Moderate: flooding.	Slight------------	Slight------------	Spring.
49A--------------- Gladden	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: flooding.	Spring.
51F:					
Beemont----------	Severe: low strength.	Severe: low strength, slope.	Moderate: slope.	Moderate: slope.	Spring*.

See footnotes at end of table.

TABLE 8.--EQUIPMENT LIMITATIONS FOR WOODLAND HARVESTING--Continued

Soil name and map symbol	Limitations for--				Most limiting season(s)
	Haul roads	Log landings	Skid trails and logging areas	Site preparation and planting	
51F:					
Ramsey----------	Severe: depth to rock.	Severe: depth to rock, slope.	Moderate: rock outcrop, slope.	Moderate: rock outcrop, slope.	Spring*, winter**.
Rock outcrop.					
60F:					
Gatewood--------	Severe: low strength.	Severe: low strength, slope.	Moderate: slope.	Moderate: slope.	Spring*, winter**.
Menfro----------	Severe: low strength.	Severe: low strength, slope.	Moderate: slope.	Moderate: slope.	None.

* Or any other periods when the soils are fully saturated.
** Only during periods when the soils are covered with ice or snow.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
01B, 01C, 01C2, 01D2 Union	Lilac	Manchurian crabapple, gray dogwood, Amur maple, autumn-olive.	Eastern redcedar, Austrian pine, hackberry, green ash, Russian-olive.	Honeylocust	---
02F. Coulstone					
03A Racoon	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Norway spruce, golden willow, northern red oak, green ash, honeylocust, silver maple.	Eastern cottonwood.
04A Freeburg	Fragrant sumac	American plum, blackhaw, gray dogwood, silky dogwood.	Washington hawthorn, eastern redcedar.	Green ash, eastern white pine, pin oak, Norway spruce, sweetgum.	---
05B, 05C Hartville	Lilac	Gray dogwood, Amur maple, autumn-olive, Manchurian crabapple.	Austrian pine, hackberry, green ash, Russian-olive, eastern redcedar.	Honeylocust	---
06C2, 06D2 Bucklick	Fragrant sumac, redosier dogwood.	Silky dogwood, American plum, arrowwood.	Blue spruce, hackberry, Washington hawthorn.	Norway spruce, green ash, eastern white pine.	Pin oak.
07B, 07C, 07E2 Menfro	---	Silky dogwood, gray dogwood, Amur privet, American cranberrybush.	Northern whitecedar, Washington hawthorn, blue spruce, white fir.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
10F: Gasconade.					
Rock outcrop.					
11 Dockery	---	Silky dogwood, gray dogwood, American cranberrybush, Amur privet.	Washington hawthorn, northern whitecedar, blue spruce, white fir, Austrian pine.	Norway spruce	Eastern white pine, pin oak.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
12. Bremer	---	Silky dogwood, Amur privet, gray dogwood, American cranberrybush.	Norway spruce, Austrian pine, blue spruce, white fir, northern whitecedar, Washington hawthorn.	Eastern white pine	Pin oak.
13A. Auxvasse	---	Gray dogwood, Amur privet, American cranberrybush, silky dogwood.	Austrian pine, northern whitecedar, white fir, blue spruce, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
16. Waldron	---	American plum, blackhaw, nannyberry viburnum, Washington hawthorn.	Eastern redcedar, green ash, northern whitecedar, white spruce.	Bur oak	---
17D. Wilderness	Lilac, fragrant sumac.	Autumn-olive	Honeylocust, Austrian pine, hackberry, eastern redcedar, green ash, bur oak, Russian-olive.	Siberian elm	---
19. Haynie	Blackhaw	Siberian peashrub	Russian-olive, eastern redcedar, Washington hawthorn.	Green ash, hackberry, honeylocust, bur oak.	Eastern cottonwood.
20. Sarpy	---	Siberian peashrub	Northern whitecedar, white spruce, nannyberry viburnum, eastern redcedar, Washington hawthorn, green ash.	Black willow	Eastern cottonwood.
23F: Weingarten	---	Lilac, gray dogwood, Amur maple, autumn-olive.	Russian-olive, hackberry, eastern redcedar.	Honeylocust, Norway spruce, green ash, pin oak, eastern white pine.	---
Gatewood	Fragrant sumac	American plum, Amur maple, Washington hawthorn.	Hackberry, Austrian pine, shortleaf pine.	---	---

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
24F Gatewood	Fragrant sumac	American plum, Amur maple, Washington hawthorn.	Hackberry, Austrian pine, shortleaf pine.	---	---
26D, 26F Beemont	---	American cranberrybush, gray dogwood, Amur privet, arrowwood, Washington hawthorn, eastern redcedar.	Austrian pine, green ash.	Pin oak, eastern white pine.	---
28C, 28D2, 28E2 Weingarten	---	Lilac, gray dogwood, Amur maple, autumn-olive.	Russian-olive, hackberry, eastern redcedar.	Honeylocust, Norway spruce, green ash, pin oak, eastern white pine.	---
31D:					
Bucklick	Fragrant sumac, redosier dogwood.	Silky dogwood, American plum, arrowwood.	Blue spruce, hackberry, Washington hawthorn.	Norway spruce, green ash, eastern white pine.	Pin oak.
Beemont	---	American cranberrybush, gray dogwood, Amur privet, arrowwood, Washington hawthorn, eastern redcedar.	Austrian pine, green ash.	Pin oak, eastern white pine.	---
Moko.					
32. Pits					
35A, 35B Glensted	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Northern red oak, honeylocust, Norway spruce, golden willow, silver maple, green ash.	Eastern cottonwood.
37 Marion	---	Gray dogwood, American cranberrybush, Amur privet, eastern redcedar, Washington hawthorn, arrowwood.	Austrian pine, green ash.	Eastern white pine, pin oak.	---

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
39----------------- Nolin	---	Gray dogwood, lilac, Amur maple, autumn-olive.	---	Eastern white pine, green ash, Austrian pine, hackberry, honeylocust, pin oak.	Eastern cottonwood.
43----------------- Cedargap	---	Gray dogwood, lilac, Amur maple, autumn-olive.	Eastern redcedar	Hackberry, eastern white pine, Austrian pine, green ash, honeylocust, pin oak.	Eastern cottonwood.
45----------------- Pope	---	Lilac, gray dogwood, autumn-olive, Amur maple.	Eastern redcedar	Austrian pine, hackberry, green ash, pin oak, eastern white pine, honeylocust.	Eastern cottonwood.
49A---------------- Gladden	---	Autumn-olive, gray dogwood, Amur maple, lilac.	Eastern redcedar	Austrian pine, honeylocust, pin oak, eastern white pine, hackberry, green ash.	Eastern cottonwood.
51F:					
Beemont-----------	---	American cranberrybush, gray dogwood, Amur privet, arrowwood, Washington hawthorn, eastern redcedar.	Austrian pine, green ash.	Pin oak, eastern white pine.	---
Ramsey------------	---	Gray dogwood, American cranberrybush, Amur privet.	Washington hawthorn, blue spruce, northern whitecedar, white fir, Austrian pine.	Norway spruce-----	Pin oak, eastern white pine.
Rock outcrop.					
60F:					
Gatewood----------	Fragrant sumac----	American plum, Amur maple, Washington hawthorn.	Hackberry, Austrian pine, shortleaf pine.	---	---
Menfro------------	---	Gray dogwood, Amur privet, American cranberrybush.	Northern whitecedar, Washington hawthorn, blue spruce, white fir.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.

TABLE 10.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
01B Union	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, small stones, wetness.	Severe: erodes easily.	Moderate: wetness.
01C, 01C2 Union	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: wetness.
01D2 Union	Moderate: slope, wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: wetness, slope.
02F Coulstone	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: slope.
03A Racoon	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
04A Freeburg	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
05B Hartville	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.	Moderate: wetness.
05C Hartville	Moderate: wetness.	Moderate: wetness.	Severe: slope.	Severe: erodes easily.	Moderate: wetness.
06C2 Bucklick	Slight	Slight	Severe: slope.	Slight	Slight.
06D2 Bucklick	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
07B Menfro	Slight	Slight	Moderate: slope.	Slight	Slight.
07C Menfro	Slight	Slight	Severe: slope.	Slight	Slight.
07E2 Menfro	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
10F:					
Gasconade	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.	Severe: slope, depth to rock.
Rock outcrop.					

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
11------------ Dockery	Severe: flooding.	Moderate: flooding, wetness.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
12------------ Bremer	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
13A----------- Auxvasse	Severe: flooding, wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
16------------ Waldron	Severe: flooding, wetness, too clayey.	Severe: too clayey.	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey.
17D----------- Wilderness	Severe: wetness.	Moderate: slope, wetness, small stones.	Severe: slope, small stones, wetness.	Moderate: wetness.	Severe: droughty.
19------------ Haynie	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
20------------ Sarpy	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy, flooding.	Severe: too sandy.	Severe: flooding.
23F:					
Weingarten----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
Gatewood------	Severe: slope.	Severe: slope.	Severe: slope, large stones.	Severe: slope.	Severe: slope.
24F----------- Gatewood	Severe: slope.	Severe: slope.	Severe: slope, large stones.	Moderate: slope.	Severe: slope.
26D----------- Beemont	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, small stones, percs slowly.	Slight	Moderate: small stones, slope.
26F----------- Beemont	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, small stones, percs slowly.	Moderate: slope.	Severe: slope.
28C----------- Weingarten	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Severe: erodes easily.	Slight.
28D2---------- Weingarten	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
28E2: Weingarten	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
31D:					
Bucklick	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Beemont	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, small stones, percs slowly.	Slight	Moderate: small stones, slope.
Moko	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: large stones.	Severe: large stones, droughty.
32. Pits					
35A, 35B: Glensted	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
37: Marion	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
39: Nolin	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
43: Cedargap	Severe: flooding, small stones.	Severe: small stones.	Severe: small stones, flooding.	Severe: small stones.	Severe: small stones, flooding.
45: Pope	Slight	Slight	Moderate: small stones.	Slight	Slight.
49A: Gladden	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
51F:					
Beemont	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, small stones, percs slowly.	Moderate: slope.	Severe: slope.
Ramsey	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.	Severe: slope, depth to rock.
Rock outcrop.					
60F:					
Gatewood	Severe: slope.	Severe: slope.	Severe: slope, large stones.	Severe: slope.	Severe: slope.
Menfro	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.

TABLE 11.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
01B Union	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
01C, 01C2, 01D2 Union	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
02F Coulstone	Very poor.	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
03A Racoon	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
04A Freeburg	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
05B, 05C Hartville	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
06C2, 06D2 Bucklick	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
07B Menfro	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
07C Menfro	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
07E2 Menfro	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
10F:										
Gasconade	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Rock outcrop.										
11 Dockery	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
12 Bremer	Good	Fair	Good	Fair	Fair	Good	Good	Good	Fair	Good.
13A Auxvasse	Fair	Good	Fair	Good	Good	Good	Fair	Fair	Good	Fair.
16 Waldron	Fair	Fair	Fair	Good	Good	Poor	Fair	Fair	Good	Poor.
17D Wilderness	Poor	Poor	Very poor.	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
19 Haynie	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
20 Sarpy	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
23F:										
Weingarten	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Gatewood	Very poor.	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
24F Gatewood	Very poor.	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
26D, 26F Beemont	Very poor.	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
28C, 28D2, 28E2 Weingarten	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
31D:										
Bucklick	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Beemont	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Moko	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
32. Pits										
35A, 35B Glensted	Fair	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
37 Marion	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
39 Nolin	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
43 Cedargap	Fair	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor.
45 Pope	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
49A Gladden	Poor	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
51F:										
Beemont	Very poor.	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Ramsey	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Rock outcrop.										

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
60F:										
Gatewood	Very poor.	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Menfro	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

TABLE 12.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
01B: Union	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength.	Moderate: wetness.
01C, 01C2: Union	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: low strength.	Moderate: wetness.
01D2: Union	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: wetness.	Severe: slope.	Severe: low strength.	Moderate: wetness, slope.
02F: Coulstone	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
03A: Racoon	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding.	Severe: low strength, ponding.	Severe: ponding.
04A: Freeburg	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, frost action.	Moderate: wetness.
05B, 05C: Hartville	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
06C2: Bucklick	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
06D2: Bucklick	Moderate: depth to rock, too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: slope.
07B: Menfro	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
07C: Menfro	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
07E2: Menfro	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: frost action, low strength, slope.	Severe: slope.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
10F:						
Gasconade--------	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.
Rock outcrop.						
11----------------- Dockery	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding, frost action.	Severe: flooding.
12----------------- Bremer	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
13A---------------- Auxvasse	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
16----------------- Waldron	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Severe: too clayey.
17D---------------- Wilderness	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, slope.	Moderate: wetness, slope, frost action.	Severe: droughty.
19----------------- Haynie	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.
20----------------- Sarpy	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
23F:						
Weingarten--------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Gatewood---------	Severe: depth to rock, wetness, slope.	Severe: shrink-swell, slope.	Severe: wetness, depth to rock, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
24F---------------- Gatewood	Severe: depth to rock, wetness, slope.	Severe: shrink-swell, slope.	Severe: wetness, depth to rock, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
26D---------------- Beemont	Moderate: too clayey, wetness, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: small stones, slope.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
26F: Beemont	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
28C: Weingarten	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
28D2: Weingarten	Moderate: too clayey, wetness, slope.	Moderate: shrink-swell, slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
28E2: Weingarten	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
31D:						
Bucklick	Moderate: depth to rock, too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: slope.
Beemont	Moderate: too clayey, wetness, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: small stones, slope.
Moko	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: large stones, droughty.
32. Pits						
35A, 35B: Glensted	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
37: Marion	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.	Moderate: wetness.
39: Nolin	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
43: Cedargap	Moderate: too clayey, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: small stones, flooding.
45: Pope	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Slight.
49A: Gladden	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
51F:						
Beemont	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
Ramsey	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.
Rock outcrop.						
60F:						
Gatewood	Severe: depth to rock, wetness, slope.	Severe: shrink-swell, slope.	Severe: wetness, depth to rock, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
Menfro	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: frost action, low strength, slope.	Severe: slope.

TABLE 13.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
01B Union	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey.
01C, 01C2 Union	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey.
01D2 Union	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: wetness, too clayey.	Moderate: wetness, slope.	Poor: too clayey.
02F Coulstone	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope, too clayey.	Severe: seepage, slope.	Poor: too clayey, small stones, slope.
03A Racoon	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
04A Freeburg	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Moderate: flooding, wetness.	Fair: too clayey, wetness.
05B Hartville	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
05C Hartville	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
06C2 Bucklick	Moderate: thin layer, seepage, percs slowly.	Severe: slope.	Severe: depth to rock, seepage.	Slight	Poor: too clayey.
06D2 Bucklick	Moderate: thin layer, seepage, percs slowly.	Severe: slope.	Severe: depth to rock, seepage.	Moderate: slope.	Poor: too clayey.
07B Menfro	Slight	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
07C Menfro	Slight	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
07E2 Menfro	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
10F:					
Gasconade	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: depth to rock, too clayey, small stones.
Rock outcrop.					
11 Dockery	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
12 Bremer	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
13A Auxvasse	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
16 Waldron	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
17D Wilderness	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, small stones.
19 Haynie	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
20 Sarpy	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: seepage, too sandy.
23F:					
Weingarten	Severe: wetness, percs slowly, slope.	Severe: slope, wetness.	Severe: slope.	Severe: slope.	Poor: slope.
Gatewood	Severe: thin layer, seepage, percs slowly.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, slope, seepage.	Severe: slope.	Poor: area reclaim, too clayey, hard to pack.
24F Gatewood	Severe: thin layer, seepage, percs slowly.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, slope, seepage.	Severe: slope.	Poor: area reclaim, too clayey, hard to pack.
26D Beemont	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
26F: Beemont	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
28C: Weingarten	Severe: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness, too clayey.	Moderate: wetness.	Fair: too clayey, wetness.
28D2: Weingarten	Severe: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness, slope, too clayey.	Moderate: wetness, slope.	Fair: too clayey, slope, wetness.
28E2: Weingarten	Severe: wetness, percs slowly, slope.	Severe: slope, wetness.	Severe: slope.	Severe: slope.	Poor: slope.
31D:					
Bucklick	Moderate: thin layer, seepage, percs slowly.	Severe: slope.	Severe: depth to rock, seepage.	Moderate: slope.	Poor: too clayey.
Beemont	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
Moko	Severe: depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock.
32. Pits					
35A, 35B: Glensted	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
37: Marion	Severe: wetness, percs slowly.	Slight	Severe: wetness.	Severe: wetness.	Poor: wetness.
39: Nolin	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
43: Cedargap	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Poor: small stones.
45: Pope	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
49A: Gladden	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding.	Fair: small stones.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
51F:					
Beemont------------	Severe: percs slowly, slope.	Severe: slope.	Severe: depth to rock, slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
Ramsey-------------	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: depth to rock, slope.
Rock outcrop.					
60F:					
Gatewood-----------	Severe: thin layer, seepage, percs slowly.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, slope, seepage.	Severe: slope.	Poor: area reclaim, too clayey, hard to pack.
Menfro-------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

TABLE 14.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
01B, 01C, 01C2, 01D2-- Union	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, area reclaim.
02F------------------- Coulstone	Fair: shrink-swell, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
03A------------------- Racoon	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
04A------------------- Freeburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
05B, 05C-------------- Hartville	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
06C2, 06D2------------ Bucklick	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, area reclaim.
07B, 07C-------------- Menfro	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
07E2------------------ Menfro	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
10F:				
Gasconade------------	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, small stones.
Rock outcrop.				
11-------------------- Dockery	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
12-------------------- Bremer	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
13A------------------- Auxvasse	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
16-------------------- Waldron	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
17D------------------- Wilderness	Fair: shrink-swell, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
19 Haynie	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
20 Sarpy	Good	Probable	Improbable: too sandy.	Poor: too sandy.
23F:				
Weingarten	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Gatewood	Poor: area reclaim, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, slope.
24F Gatewood	Poor: area reclaim, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, slope.
26D Beemont	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
26F Beemont	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, slope.
28C Weingarten	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, area reclaim.
28D2 Weingarten	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, area reclaim, slope.
28E2 Weingarten	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
31D:				
Bucklick	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, area reclaim.
Beemont	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
Moko	Poor: depth to rock, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, large stones.
32. Pits				
35A, 35B Glensted	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
37: Marion	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
39: Nolin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
43: Cedargap	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
45: Pope	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
49A: Gladden	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
51F:				
Beemont	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, area reclaim.
Ramsey	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.
Rock outcrop.				
60F:				
Gatewood	Poor: area reclaim, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, slope.
Menfro	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

TABLE 15.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
01B, 01C, 01C2---- Union	Moderate: seepage, slope.	Moderate: thin layer, wetness.	Percs slowly, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, rooting depth.
01D2-------------- Union	Severe: slope.	Moderate: thin layer, wetness.	Percs slowly, slope.	Slope, wetness, percs slowly.	Slope, erodes easily, wetness.	Slope, erodes easily, rooting depth.
02F--------------- Coulstone	Severe: seepage, slope.	Slight---------	Deep to water	Slope, droughty.	Slope----------	Slope, droughty.
03A--------------- Racoon	Slight---------	Severe: thin layer, ponding.	Ponding, percs slowly.	Ponding, percs slowly, erodes easily.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
04A--------------- Freeburg	Slight---------	Moderate: wetness.	Frost action---	Wetness, erodes easily.	Erodes easily, wetness.	Erodes easily.
05B, 05C---------- Hartville	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
06C2-------------- Bucklick	Moderate: seepage, depth to rock, slope.	Moderate: thin layer.	Deep to water	Slope----------	Favorable------	Favorable.
06D2-------------- Bucklick	Severe: slope.	Moderate: thin layer.	Deep to water	Slope----------	Slope----------	Slope.
07B, 07C---------- Menfro	Moderate: slope, seepage.	Slight---------	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
07E2-------------- Menfro	Severe: slope.	Slight---------	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
10F: Gasconade---------	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Slope, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Rock outcrop.						
11---------------- Dockery	Moderate: seepage.	Moderate: piping, wetness.	Flooding, frost action.	Wetness, erodes easily.	Erodes easily, wetness.	Erodes easily.
12---------------- Bremer	Slight---------	Severe: hard to pack, wetness.	Frost action---	Wetness--------	Erodes easily, wetness.	Wetness, erodes easily.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
13A----------------- Auxvasse	Slight----------	Moderate: wetness.	Percs slowly---	Wetness, percs slowly, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
16----------------- Waldron	Moderate: seepage.	Severe: hard to pack, wetness.	Percs slowly, flooding, frost action.	Wetness, slow intake, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
17D---------------- Wilderness	Severe: slope.	Moderate: large stones, wetness.	Percs slowly, large stones, slope.	Slope, large stones, wetness.	Slope, large stones, wetness.	Large stones, wetness, slope.
19----------------- Haynie	Moderate: seepage.	Severe: piping.	Deep to water	Soil blowing---	Erodes easily, soil blowing.	Erodes easily.
20----------------- Sarpy	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Droughty.
23F:						
Weingarten--------	Severe: slope.	Moderate: piping, wetness.	Slope-----------	Slope, wetness, erodes easily.	Slope, erodes easily, wetness.	Slope, erodes easily.
Gatewood----------	Severe: slope.	Severe: hard to pack.	Percs slowly, depth to rock, slope.	Slope, percs slowly.	Depth to rock, slope, area reclaim.	Depth to rock, slope, area reclaim.
24F---------------- Gatewood	Severe: slope.	Severe: hard to pack.	Percs slowly, depth to rock, slope.	Slope, percs slowly.	Depth to rock, slope, area reclaim.	Depth to rock, slope, area reclaim.
26D, 26F----------- Beemont	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, percs slowly.	Slope, percs slowly.	Slope, percs slowly.
28C---------------- Weingarten	Moderate: seepage, slope.	Moderate: piping, wetness.	Slope-----------	Slope, wetness, erodes easily.	Erodes easily, wetness.	Erodes easily.
28D2, 28E2--------- Weingarten	Severe: slope.	Moderate: piping, wetness.	Slope-----------	Slope, wetness, erodes easily.	Slope, erodes easily, wetness.	Slope, erodes easily.
31D:						
Bucklick----------	Severe: slope.	Moderate: thin layer.	Deep to water	Slope-----------	Slope-----------	Slope.
Beemont-----------	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, percs slowly.	Slope, percs slowly.	Slope, percs slowly.
Moko--------------	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Slope, large stones, droughty.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
32. Pits						
35A---------------- Glensted	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness---------	Wetness, percs slowly.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
35B----------------- Glensted	Moderate: seepage, slope.	Severe: wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Wetness---------	Wetness, percs slowly.
37----------------- Marion	Slight---------	Moderate: wetness.	Percs slowly---	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
39----------------- Nolin	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily, flooding.	Erodes easily	Erodes easily.
43----------------- Cedargap	Moderate: seepage.	Slight---------	Deep to water	Droughty, percs slowly, flooding.	Favorable------	Droughty.
45----------------- Pope	Severe: seepage.	Severe: piping.	Deep to water	Favorable------	Favorable------	Favorable.
49A---------------- Gladden	Severe: seepage.	Severe: piping.	Deep to water	Flooding-------	Favorable------	Favorable.
51F:						
Beemont-----------	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, percs slowly.	Slope, percs slowly.	Slope, percs slowly.
Ramsey------------	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Slope, droughty, depth to rock.	Slope, depth to rock.	Slope, droughty, depth to rock.
Rock outcrop.						
60F:						
Gatewood----------	Severe: slope.	Severe: hard to pack.	Percs slowly, depth to rock, slope.	Slope, percs slowly.	Depth to rock, slope, area reclaim.	Depth to rock, slope, area reclaim.
Menfro------------	Severe: slope.	Slight---------	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.

TABLE 16.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct	Pct					Pct	
01B, 01C, 01C2, 01D2--- Union	0-8	Silt loam-----	CL-ML, CL	A-4, A-6	0	0-5	85-100	85-100	80-95	60-75	22-35	5-15
	8-28	Silty clay loam, silty clay.	CL	A-6, A-7	0	0-10	85-95	80-90	75-85	65-85	35-50	15-30
	28-50	Silt loam, gravelly silt loam, very gravelly silty clay loam.	CL, SC	A-7, A-6, A-4, A-2	0	0-20	85-95	40-90	35-85	30-75	25-45	8-22
	50-60	Clay, very gravelly clay, gravelly silty clay.	CL, CH, SC, GC	A-7	0	0-20	65-95	50-90	45-65	40-60	45-80	25-45
02F----------- Coulstone	0-16	Gravelly fine sandy loam.	CL-ML, CL, SC, SC-SM	A-4, A-1-b, A-2-4	0-5	0-10	55-80	50-75	30-70	20-60	20-30	5-10
	16-30	Very gravelly loam, very gravelly sandy loam, extremely cobbly sandy loam.	GM, GC, GP-GM, GM-GC	A-4, A-2-4, A-1-b	0-5	0-55	25-55	5-50	15-45	5-45	15-30	2-10
	30-37	Very gravelly sandy loam, very gravelly loam.	GM, GC, GM-GC	A-4, A-2-4, A-1-b	0-5	0-10	30-55	25-50	15-50	10-45	15-30	2-10
	37-60	Very gravelly clay loam, very gravelly silty clay.	GC	A-6, A-7, A-2	0-5	0-10	30-55	25-50	20-45	20-45	30-50	11-25
03A----------- Racoon	0-9	Silt loam-----	CL	A-4, A-6	0	0	100	100	95-100	90-100	20-40	8-20
	9-27	Silt loam-----	CL, CL-ML	A-4, A-6	0	0	100	100	95-100	90-100	20-40	5-20
	27-60	Silty clay loam.	CL	A-6, A-7	0	0	100	100	95-100	85-100	35-50	15-30
04A----------- Freeburg	0-19	Silt loam-----	CL, CL-ML	A-4, A-6	0	0	100	100	90-100	90-100	15-35	5-15
	19-24	Silty clay loam, silt loam.	CL	A-6, A-7	0	0	100	100	85-100	85-100	30-45	15-25
	24-41	Clay loam, silty clay loam.	CL	A-6, A-7	0	0	100	100	85-100	70-100	30-45	15-25
	41-60	Silty clay loam, clay loam, silt loam.	CL	A-6, A-7	0	0	100	100	85-100	85-100	30-45	15-25
05B, 05C------ Hartville	0-9	Silt loam-----	ML, CL	A-4, A-6	0	0-5	95-100	95-100	80-95	70-90	30-40	7-15
	9-20	Silt loam, silty clay loam.	CL	A-6, A-7	0	0-10	95-100	95-100	90-98	85-95	35-45	20-25
	20-60	Silty clay, clay, silty clay loam.	CH	A-7	0	0-10	95-100	95-100	90-98	85-95	50-60	30-40

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 10 inches	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
06C2, 06D2---- Bucklick	0-7	Silt loam-----	CL-ML, CL	A-4, A-6	0	0	100	100	95-100	80-95	25-40	5-15
	7-48	Silty clay loam, silty clay, clay loam.	CL	A-7	0	0	95-100	85-100	80-100	65-95	40-50	20-30
	48-54	Very gravelly silty clay, gravelly silty clay loam, silty clay.	CL, SC, GC	A-7	0	0-15	40-100	35-100	35-100	50-95	40-50	20-30
	54	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
07B, 07C, 07E2--------- Menfro	0-7	Silt loam-----	CL	A-6	0	0	100	100	95-100	90-100	25-35	11-20
	7-12	Silt loam, silty clay loam.	CL	A-6	0	0	100	100	95-100	90-100	25-40	11-20
	12-33	Silty clay loam.	CL	A-6, A-7	0	0	100	100	95-100	95-100	35-45	20-25
	33-60	Silt loam-----	CL-ML, CL	A-4, A-6	0	0	100	100	95-100	90-100	25-35	5-15
10F: Gasconade----	0-2	Gravelly clay loam.	GC, CL	A-7-6	0	0-15	60-85	55-70	40-65	35-60	38-43	15-18
	2-18	Very gravelly clay, extremely gravelly clay, very gravelly silty clay.	GC	A-2-6, A-2-7	0-2	0-20	40-55	35-50	20-40	20-35	38-61	15-32
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Rock outcrop.												
11------------ Dockery	0-6	Silt loam-----	CL-ML, CL	A-4, A-6	0	0	100	100	90-100	85-100	25-35	5-15
	6-60	Silt loam, silty clay loam.	CL	A-4, A-6	0	0	100	100	90-100	85-95	25-40	8-20
12------------ Bremer	0-15	Silty clay loam.	CH, CL	A-7	0	0	100	100	100	95-100	45-60	25-40
	15-60	Silty clay loam, silty clay.	CH, MH	A-7	0	0	100	100	100	95-100	50-65	20-35
13A----------- Auxvasse	0-11	Silt loam-----	CL-ML, CL	A-4, A-6	0	0	100	100	90-100	85-100	25-35	5-15
	11-33	Silty clay, clay.	CH	A-7	0	0	100	100	95-100	90-100	50-65	30-40
	33-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	0	100	100	90-100	90-96	35-45	20-25

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
16------------ Waldron	0-9	Silty clay----	CL, CH	A-7	0	0	100	100	95-100	90-100	45-65	30-45
	9-55	Stratified silty clay loam to silty clay.	CL, CH	A-7	0	0	100	100	95-100	90-100	40-65	20-45
	55-60	Stratified very fine sandy loam to silt loam.	CL, CL-ML	A-4, A-6	0	0	100	100	85-95	50-75	25-35	5-15
17D----------- Wilderness	0-4	Gravelly silt loam.	SC-SM, SC, SP-SC, GC	A-1, A-4, A-2-4	0	0-10	60-85	50-75	45-75	35-60	20-30	5-10
	4-17	Very gravelly silt loam, extremely gravelly silty clay loam.	GC, GP-GC, SC, SP-SC	A-6, A-2-6	0-5	0-15	18-55	10-50	10-50	10-40	25-40	10-20
	17-42	Extremely gravelly silt loam, very gravelly silty clay loam.	GM-GC, GC, GP-GC	A-1, A-2-4, A-2-6	0-10	0-40	30-60	10-45	10-40	5-35	20-40	5-15
	42-60	Gravelly clay, clay.	CL	A-6	0	0-5	85-100	60-100	55-100	50-90	25-40	15-25
19------------ Haynie	0-9	Very fine sandy loam.	CL-ML, ML	A-4	0	0	100	100	85-95	50-65	<25	NP-5
	9-60	Silt loam, very fine sandy loam.	CL-ML, CL	A-4, A-6	0	0	100	100	85-100	50-85	25-35	5-15
20------------ Sarpy	0-4	Fine sand-----	SM, SP-SM, SP	A-2-4, A-3	0	0	100	100	60-80	2-15	---	NP
	4-60	Fine sand, loamy fine sand, sand.	SM, SP, SP-SM	A-2-4, A-3	0	0	100	100	60-80	2-35	---	NP
23F:												
Weingarten---	0-6	Silt loam-----	CL-ML, CL	A-4, A-6	0	0	100	100	100	95-100	20-35	5-15
	6-23	Silty clay loam, silt loam.	CL	A-6, A-7	0	0	100	95-100	95-100	95-100	30-45	11-25
	23-36	Silt loam, silty clay loam.	CL	A-4, A-6	0	0	100	95-100	95-100	95-100	25-40	7-18
	36-65	Gravelly clay, gravelly silty clay loam, silty clay.	GC, CL, CH, SC	A-7	0	0-25	45-95	40-90	40-90	35-85	45-65	25-40
Gatewood-----	0-9	Gravelly silt loam.	CL, SC, GC	A-4, A-6, A-2	0	5-20	55-80	50-75	45-75	45-70	25-35	7-15
	9-36	Gravelly silty clay, gravelly clay, clay.	CH	A-7	0-5	0-10	55-80	50-75	45-75	45-70	55-75	30-45
	36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 10 inches	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
24F-----------Gatewood	0-10	Gravelly silt loam.	CL, SC, GC	A-4, A-6, A-2	0	5-20	70-90	65-75	40-75	30-70	25-35	7-15
	10-30	Gravelly silty clay, gravelly clay, clay.	CH	A-7	0-5	0-10	60-95	55-95	55-90	55-90	55-75	30-45
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
26D-----------Beemont	0-3	Gravelly silt loam.	GC, CL, SC, ML	A-6, A-4	0	0-10	60-80	50-75	25-75	25-75	15-35	NP-15
	3-18	Gravelly silt loam, gravelly loam.	GC, CL, ML, SC	A-6, A-4	0	0-10	60-80	50-75	25-75	25-75	15-35	NP-15
	18-50	Clay-----------	CH	A-7	0	0-5	80-100	75-100	70-100	65-95	65-90	45-70
	50-60	Gravelly silty clay, gravelly clay, clay.	GC, CH, SC, CL	A-7	0	0-15	60-90	50-75	45-75	40-75	40-65	20-45
26F-----------Beemont	0-2	Gravelly silt loam.	GC, CL, SC, ML	A-6, A-4	0	0-10	60-80	50-75	25-75	25-75	15-35	NP-15
	2-17	Gravelly silt loam, gravelly loam.	GC, CL, ML, SC	A-6, A-4	0	0-10	60-80	50-75	25-75	25-75	15-35	NP-15
	17-46	Clay-----------	CH	A-7	0	0-5	80-100	75-100	70-100	65-95	65-90	45-70
	46-60	Clay loam, silty clay loam, silty clay.	CL	A-7	0	0-10	95-100	85-100	80-100	65-95	40-50	20-30
28C, 28D2, 28E2---------Weingarten	0-7	Silt loam-----	CL-ML, CL	A-4, A-6	0	0	100	100	100	95-100	20-35	5-15
	7-33	Silty clay loam, silt loam.	CL	A-6, A-7	0	0	100	95-100	95-100	95-100	30-45	11-25
	33-53	Silt loam, silty clay loam.	CL	A-4, A-6	0	0	100	95-100	95-100	95-100	25-40	7-18
	53-65	Gravelly clay, gravelly silty clay loam, silty clay.	GC, CL, CH, SC	A-7	0	0-25	45-95	40-90	40-90	35-85	45-65	25-40
31D: Bucklick-----	0-5	Silt loam-----	CL-ML, CL	A-4, A-6	0	0	100	100	95-100	80-95	25-40	5-15
	5-31	Silty clay loam, silty clay, clay loam.	CL	A-7	0	0	95-100	85-100	80-100	65-95	40-50	20-30
	31-53	Very gravelly silty clay, gravelly silty clay loam, silty clay.	CL, SC, GC	A-7	0	0-15	40-100	35-95	35-95	30-95	40-50	20-30
	53	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 10 inches	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
31D:												
Beemont------	0-4	Gravelly silt loam.	GC, CL, SC, ML	A-6, A-4	0	0-10	60-80	50-75	25-75	25-75	15-35	NP-15
	4-21	Gravelly silt loam, gravelly loam.	GC, CL, ML, SC	A-6, A-4	0	0-10	60-80	50-75	25-75	25-75	15-35	NP-15
	21-60	Clay----------	CH	A-7	0	0-5	80-100	75-100	70-100	65-95	65-90	45-70
Moko---------	0-1	Very flaggy silt loam.	CL, GC, SC	A-6	0-15	40-65	65-90	60-85	55-75	40-70	25-35	10-15
	1-6	Very flaggy silt loam, very flaggy silty clay loam.	CL, GC, SC	A-6, A-7	0-15	40-80	65-90	60-85	55-80	40-70	25-45	10-20
	6	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
32. Pits												
35A----------- Glensted	0-7	Silt loam-----	CL	A-6	0	0	100	100	95-100	80-95	30-40	12-22
	7-25	Silty clay----	CH	A-7	0	0	100	100	95-100	90-95	55-65	30-40
	25-35	Silty clay loam, silty clay.	CL, CH	A-7	0	0	95-100	80-95	75-95	65-85	45-60	25-35
	35-65	Silty clay loam, clay loam.	CL	A-7	0	0	95-100	80-95	75-90	60-80	40-50	20-30
35B----------- Glensted	0-8	Silt loam-----	CL	A-6	0	0	100	100	95-100	80-95	30-40	12-22
	8-19	Silty clay, clay.	CH	A-7	0	0	95-100	80-95	75-95	70-85	55-75	30-50
	19-60	Silty clay loam, silty clay.	CL, CH	A-7	0	0	95-100	80-95	75-95	65-85	45-60	25-35
37------------ Marion	0-12	Silt loam-----	ML, CL	A-4, A-6	0	0	100	100	90-100	90-100	30-40	5-15
	12-30	Silty clay----	CH	A-7	0	0	100	100	95-100	90-100	50-65	30-40
	30-60	Silty clay loam.	CL	A-6, A-7	0	0	100	100	95-100	85-95	35-45	20-25
39------------ Nolin	0-9	Silt loam-----	CL-ML	A-4, A-6	0	0	100	95-100	90-100	80-100	25-40	5-18
	9-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6, A-7	0	0	100	95-100	85-100	75-100	25-46	5-23

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 10 inches	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
43------------ Cedargap	0-10	Gravelly loam	GC, SC-SM, SC	A-1, A-2-4, A-4	0	0-10	60-80	50-75	40-70	30-60	18-32	4-12
	10-26	Extremely gravelly loam, extremely gravelly silt loam.	GC, GP-GC, GM-GC	A-2-4, A-2-6	0	0-10	15-30	10-25	5-15	5-15	21-32	6-12
	26-44	Very gravelly loam, very gravelly silt loam.	GC, GM-GC	A-2-4, A-4	0	0-10	30-55	25-50	15-40	15-40	21-32	6-12
	44-53	Extremely gravelly loam, extremely cobbly loam.	GC, GP-GC, GM-GC	A-2-4, A-2-6	0	20-50	15-30	10-25	5-15	5-15	21-32	6-12
	53-60	Extremely gravelly clay, extremely gravelly silty clay, extremely cobbly clay.	GC, GM	A-2-7	0	20-50	15-30	10-25	5-15	5-15	43-52	18-23
45------------ Pope	0-10	Fine sandy loam.	SM, ML, CL-ML, SC-SM	A-2, A-4	0	0	85-100	75-100	51-85	25-55	<20	NP-5
	10-60	Fine sandy loam, sandy loam, loam.	SM, SC-SM, ML, CL-ML	A-2, A-4	0	0	85-100	80-100	51-95	25-75	<30	NP-7
49A----------- Gladden	0-9	Loam----------	CL, CL-ML, SC	A-6, A-4	0	0	80-100	75-100	60-90	45-75	15-35	3-15
	9-36	Silt loam, sandy loam, loam.	ML, CL, SM, SC	A-4	0	0-15	80-100	75-100	55-85	30-90	<25	NP-10
	36-42	Gravelly loam, gravelly fine sandy loam, gravelly sandy loam.	GC, SC, CL, CL-ML	A-4	0	0-15	55-80	50-75	40-70	25-60	20-30	5-10
	42-60	Very gravelly loam, extremely gravelly sandy loam, very gravelly sandy loam.	GM, GC	A-1, A-2-4	0	0-20	30-45	15-40	10-30	5-20	<25	NP-10
51F:												
Beemont------	0-5	Gravelly loam	GC, CL, SC, ML	A-6, A-4	0	0-10	60-80	50-75	45-75	40-70	15-35	NP-15
	5-15	Gravelly silt loam, gravelly loam.	GC, CL, ML, SC	A-6, A-4	0	0-10	60-80	50-75	25-75	25-75	15-35	NP-15
	15-68	Clay----------	CH	A-7	0	0-5	80-100	75-100	70-100	65-95	65-90	45-70

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 10 inches	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
51F:												
Ramsey--------	0-5	Fine sandy loam.	SM, CL-ML, ML, SC-SM	A-4, A-2	---	0-10	85-100	75-95	60-75	30-55	<25	NP-7
	5-13	Loam, sandy loam, fine sandy loam.	SM, CL-ML, ML, SC-SM	A-4, A-2	---	0-10	85-100	75-95	50-90	30-70	<25	NP-7
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Rock outcrop.												
60F:												
Gatewood------	0-9	Gravelly silt loam.	CL, SC, GC	A-4, A-6, A-2	0	5-20	70-90	50-75	40-75	30-70	25-35	7-15
	9-23	Gravelly silty clay, gravelly clay, clay.	CH	A-7	0-5	0-10	60-95	55-95	55-90	55-95	55-75	30-45
	23	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Menfro--------	0-3	Silt loam-----	CL	A-6	0	0	100	100	95-100	90-100	25-35	11-20
	3-9	Silt loam, silty clay loam.	CL	A-6	0	0	100	100	95-100	90-100	25-40	11-20
	9-25	Silty clay loam.	CL	A-6, A-7	0	0	100	100	95-100	95-100	35-45	20-25
	25-60	Silt loam-----	CL-ML, CL	A-4, A-6	0	0	100	100	95-100	90-100	25-35	5-15

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH				Pct
01B, 01C, 01C2, 01D2------------ Union	0-8	10-27	1.35-1.45	0.6-2.0	0.18-0.22	5.6-6.5	Moderate-----	0.43	4	1-2
	8-28	27-40	1.30-1.40	0.6-2.0	0.14-0.19	4.5-5.5	Moderate-----	0.43		
	28-50	15-35	1.60-1.90	0.06-0.2	0.01-0.05	3.6-5.0	Moderate-----	0.43		
	50-60	40-80	1.30-1.40	0.06-0.2	0.12-0.18	4.5-6.0	High---------	0.43		
02F-------------- Coulstone	0-16	15-25	1.30-1.50	2.0-6.0	0.12-0.17	3.6-5.5	Low----------	0.24	3	1-2
	16-30	10-25	1.30-1.50	2.0-6.0	0.05-0.11	3.6-5.5	Low----------	0.24		
	30-37	10-25	1.30-1.50	2.0-6.0	0.04-0.11	3.6-5.0	Low----------	0.24		
	37-60	30-50	1.10-1.40	2.0-6.0	0.04-0.09	3.6-5.0	Moderate-----	0.24		
03A-------------- Racoon	0-9	20-27	1.30-1.50	0.2-0.6	0.22-0.24	4.5-7.3	Moderate-----	0.37	3	1-2
	9-27	18-25	1.35-1.50	0.2-0.6	0.20-0.22	4.5-7.3	Moderate-----	0.37		
	27-60	27-35	1.35-1.60	0.06-0.2	0.18-0.20	4.5-5.5	High---------	0.37		
04A-------------- Freeburg	0-19	12-25	1.20-1.45	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.37	5	1-2
	19-24	25-35	1.40-1.50	0.6-2.0	0.18-0.20	4.5-6.5	Moderate-----	0.37		
	24-41	27-35	1.40-1.50	0.2-0.6	0.15-0.19	4.5-5.5	Moderate-----	0.37		
	41-60	25-32	1.35-1.50	0.2-0.6	0.16-0.20	4.5-7.3	Moderate-----	0.37		
05B, 05C--------- Hartville	0-9	20-27	1.10-1.30	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.43	3	1-2
	9-20	24-40	1.20-1.40	0.06-0.2	0.18-0.21	4.5-6.0	Moderate-----	0.43		
	20-60	35-60	1.20-1.50	0.06-0.2	0.10-0.12	4.5-6.5	High---------	0.32		
06C2, 06D2------- Bucklick	0-7	15-25	1.35-1.45	0.6-2.0	0.15-0.24	4.5-7.3	Low----------	0.32	4	2-4
	7-48	35-45	1.25-1.35	0.6-2.0	0.10-0.18	4.5-7.3	High---------	0.32		
	48-54	35-45	1.25-1.55	0.6-2.0	0.08-0.18	5.1-7.3	High---------	0.32		
	54	---	---	0.01-0.06	---	---	-------------	----		
07B, 07C, 07E2--- Menfro	0-7	18-27	1.25-1.40	0.6-2.0	0.22-0.24	5.1-7.3	Low----------	0.37	5	1-2
	7-12	25-30	1.30-1.45	0.6-2.0	0.18-0.22	5.1-7.3	Moderate-----	0.37		
	12-33	27-33	1.35-1.50	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.37		
	33-60	8-20	1.30-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.37		
10F:										
Gasconade-------	0-2	35-40	1.35-1.50	0.06-0.2	0.13-0.15	6.1-7.8	Moderate-----	0.28	2	2-4
	2-18	40-60	1.35-1.50	0.2-0.6	0.07-0.11	6.1-7.8	Moderate-----	0.24		
	18	---	---	0.00-0.06	---	---	-------------	----		
Rock outcrop.										
11--------------- Dockery	0-6	15-27	1.35-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.37	5	2-4
	6-60	18-30	1.35-1.45	0.6-2.0	0.20-0.24	5.6-7.8	Moderate-----	0.37		
12--------------- Bremer	0-15	27-36	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	5-7
	15-60	35-42	1.30-1.40	0.2-0.6	0.15-0.17	5.6-6.5	High---------	0.43		
13A-------------- Auxvasse	0-11	8-16	1.30-1.45	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.43	3	.5-1
	11-33	45-60	1.35-1.50	<0.06	0.09-0.11	4.5-7.8	High---------	0.43		
	33-60	25-40	1.35-1.50	0.2-0.6	0.18-0.20	4.5-7.8	Moderate-----	0.43		
16--------------- Waldron	0-9	40-50	1.35-1.45	0.06-0.2	0.12-0.14	6.6-7.8	High---------	0.32	5	2-4
	9-55	35-50	1.30-1.50	0.06-0.2	0.10-0.18	7.4-8.4	High---------	0.32		
	55-60	15-20	1.40-1.50	0.6-2.0	0.18-0.20	7.4-8.4	Low----------	0.43		

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH				Pct
17D----------------	0-4	18-25	1.20-1.45	2.0-6.0	0.07-0.12	4.5-6.5	Low-----------	0.28	2	1-2
Wilderness	4-17	20-35	1.30-1.50	0.6-2.0	0.03-0.10	4.5-6.0	Low-----------	0.28		
	17-42	20-35	1.70-2.00	0.06-0.2	0.01-0.05	3.6-5.5	Low-----------	0.28		
	42-60	50-70	1.40-1.60	0.6-2.0	0.08-0.10	4.5-6.0	Moderate------	0.20		
19----------------	0-9	15-18	1.20-1.35	0.6-2.0	0.18-0.23	6.6-8.4	Low-----------	0.32	5	2-3
Haynie	9-60	15-18	1.20-1.35	0.6-2.0	0.18-0.23	7.4-8.4	Low-----------	0.43		
20----------------	0-4	2-5	1.20-1.50	>6.0	0.05-0.09	6.6-8.4	Low-----------	0.15	5	.5-1
Sarpy	4-60	2-5	1.20-1.50	>6.0	0.05-0.09	7.4-8.4	Low-----------	0.15		
23F:										
Weingarten-------	0-6	10-27	1.30-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.37	5	1-2
	6-23	20-35	1.30-1.60	0.6-2.0	0.18-0.20	4.5-6.0	Moderate------	0.37		
	23-36	15-30	1.50-1.70	0.2-0.6	0.10-0.15	5.1-6.5	Low-----------	0.37		
	36-65	35-60	1.30-1.50	0.6-2.0	0.05-0.10	5.1-7.8	Moderate------	0.24		
Gatewood---------	0-9	15-25	1.10-1.40	0.6-2.0	0.12-0.17	5.1-7.3	Low-----------	0.32	3	.5-1
	9-36	55-85	1.10-1.30	0.06-0.2	0.09-0.12	4.5-7.3	High----------	0.24		
	36	---	---	0.00-0.06	---	---	--------------	----		
24F---------------	0-10	15-25	1.10-1.40	0.6-2.0	0.12-0.17	5.1-7.3	Low-----------	0.32	3	1-2
Gatewood	10-30	55-85	1.10-1.30	0.06-0.2	0.09-0.12	4.5-7.3	High----------	0.24		
	30	---	---	0.00-0.06	---	---	--------------	----		
26D---------------	0-3	10-27	1.30-1.40	2.0-6.0	0.14-0.17	4.5-6.5	Low-----------	0.32	3	1-2
Beemont	3-18	10-27	1.30-1.45	2.0-6.0	0.14-0.17	3.6-6.0	Low-----------	0.32		
	18-50	60-85	1.35-1.45	<0.06	0.09-0.12	4.5-5.5	High----------	0.24		
	50-60	35-60	1.40-1.55	<0.06	0.09-0.15	4.5-5.5	High----------	0.20		
26F---------------	0-2	10-27	1.30-1.40	2.0-6.0	0.14-0.17	4.5-6.5	Low-----------	0.32	3	1-2
Beemont	2-17	10-27	1.30-1.45	2.0-6.0	0.14-0.17	3.6-6.0	Low-----------	0.32		
	17-46	60-85	1.35-1.45	<0.06	0.09-0.12	4.5-5.5	High----------	0.24		
	46-60	35-45	1.25-1.35	<0.06	0.10-0.18	4.5-6.5	High----------	0.20		
28C, 28D2, 28E2--	0-7	10-27	1.30-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.37	5	1-2
Weingarten	7-33	20-35	1.30-1.60	0.6-2.0	0.18-0.20	4.5-6.0	Moderate------	0.37		
	33-53	15-35	1.50-1.70	0.2-0.6	0.10-0.15	5.1-6.5	Low-----------	0.37		
	53-65	35-60	1.30-1.50	0.6-2.0	0.05-0.10	5.1-7.8	Moderate------	0.24		
31D:										
Bucklick---------	0-5	15-25	1.35-1.45	0.6-2.0	0.15-0.24	4.5-7.3	Low-----------	0.32	4	2-4
	5-31	35-45	1.25-1.35	0.6-2.0	0.10-0.18	4.5-7.3	High----------	0.32		
	31-53	35-45	1.25-1.55	0.6-2.0	0.08-0.18	5.1-7.3	High----------	0.32		
	53	---	---	0.01-0.06	---	---	--------------	----		
Beemont----------	0-4	10-27	1.30-1.40	2.0-6.0	0.14-0.17	4.5-6.5	Low-----------	0.32	3	1-2
	4-21	10-27	1.30-1.45	2.0-6.0	0.14-0.17	3.6-6.0	Low-----------	0.32		
	21-60	60-85	1.35-1.45	<0.06	0.09-0.12	4.5-5.5	High----------	0.24		
Moko-------------	0-1	18-27	1.25-1.60	0.6-2.0	0.07-0.13	6.6-7.8	Low-----------	0.24	1	2-4
	1-6	18-35	1.25-1.60	0.6-2.0	0.03-0.14	6.6-7.8	Low-----------	0.28		
	6	---	---	0.01-0.6	---	---	--------------	----		
32.										
Pits										
35A---------------	0-7	18-27	1.30-1.50	0.6-2.0	0.22-0.24	5.1-7.3	Moderate------	0.32	3	2-3
Glensted	7-25	40-50	1.30-1.45	0.06-0.2	0.11-0.13	5.1-6.5	High----------	0.32		
	25-35	27-44	1.30-1.45	0.2-0.6	0.11-0.20	5.6-7.3	Moderate------	0.32		
	35-65	27-35	1.30-1.45	0.6-2.0	0.15-0.20	5.6-7.8	Moderate------	0.32		

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH				Pct
35B---------------- Glensted	0-8	18-27	1.30-1.50	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.32	3	2-3
	8-19	40-50	1.30-1.45	0.06-0.2	0.09-0.13	5.1-6.5	High---------	0.32		
	19-60	27-44	1.30-1.45	0.2-0.6	0.11-0.20	5.6-7.3	Moderate-----	0.32		
37---------------- Marion	0-12	12-27	1.30-1.45	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.43	3	1-2
	12-30	48-60	1.30-1.65	<0.06	0.11-0.13	3.6-5.5	High---------	0.32		
	30-60	30-40	1.30-1.55	0.06-0.2	0.15-0.17	3.6-6.0	Moderate-----	0.43		
39---------------- Nolin	0-9	12-27	1.20-1.40	0.6-2.0	0.18-0.23	5.6-8.4	Low----------	0.43	5	1-2
	9-60	18-35	1.25-1.50	0.6-2.0	0.18-0.23	5.6-8.4	Low----------	0.43		
43---------------- Cedargap	0-10	12-28	1.20-1.45	0.6-2.0	0.10-0.15	5.6-7.3	Low----------	0.24	5	2-4
	10-26	15-28	1.30-1.50	0.6-2.0	0.05-0.08	5.6-7.3	Low----------	0.32		
	26-44	15-28	1.30-1.50	0.6-2.0	0.09-0.12	5.6-7.3	Low----------	0.32		
	44-53	15-28	1.30-1.50	0.6-2.0	0.05-0.08	5.6-7.3	Low----------	0.32		
	53-60	40-50	1.20-1.40	0.02-0.06	0.04-0.08	5.6-7.3	Moderate-----	0.20		
45---------------- Pope	0-10	5-15	1.20-1.40	2.0-6.0	0.10-0.16	3.6-5.5	Low----------	0.28	5	1-2
	10-60	5-18	1.30-1.60	0.6-2.0	0.10-0.18	3.6-5.5	Low----------	0.28		
49A--------------- Gladden	0-9	8-27	1.25-1.45	0.6-2.0	0.20-0.22	5.1-7.3	Low----------	0.32	4	2-4
	9-36	10-18	1.30-1.50	0.6-2.0	0.12-0.18	5.1-7.3	Low----------	0.32		
	36-42	10-18	1.30-1.55	0.6-2.0	0.10-0.15	5.1-7.3	Low----------	0.32		
	42-60	5-18	1.30-1.55	2.0-6.0	0.01-0.03	5.1-7.3	Low----------	0.24		
51F:										
Beemont----------	0-5	10-27	1.30-1.40	2.0-6.0	0.14-0.17	4.5-6.5	Low----------	0.32	3	1-2
	5-15	10-27	1.30-1.45	2.0-6.0	0.14-0.17	3.6-6.0	Low----------	0.32		
	15-68	60-85	1.35-1.45	<0.06	0.09-0.12	4.5-5.5	High---------	0.24		
Ramsey-----------	0-5	8-25	1.25-1.50	6.0-20	0.09-0.12	4.5-6.5	Low----------	0.20	1	.5-1
	5-13	8-25	1.20-1.40	6.0-20	0.09-0.12	4.5-6.5	Low----------	0.17		
	13	---	---	0.01-0.06	---	---	-------------	----		
Rock outcrop.										
60F:										
Gatewood---------	0-9	15-25	1.10-1.40	0.6-2.0	0.12-0.17	5.1-7.3	Low----------	0.32	3	1-2
	9-23	60-85	1.10-1.30	0.06-0.2	0.09-0.12	4.5-7.3	High---------	0.24		
	23	---	---	0.01-0.06	---	---	-------------	----		
Menfro-----------	0-3	18-27	1.25-1.40	0.6-2.0	0.22-0.24	5.1-7.3	Low----------	0.37	5	1-2
	3-9	25-30	1.30-1.45	0.6-2.0	0.18-0.22	5.1-7.3	Moderate-----	0.37		
	9-25	27-33	1.35-1.50	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.37		
	25-60	8-20	1.30-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.37		

TABLE 18.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
01B, 01C, 01C2, 01D2 Union	C	None	---	---	1.5-3.0	Perched	Nov-Mar	>60	---	Moderate	High	High.
02F Coulstone	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	High.
03A Racoon	C/D	Rare	---	---	0-1.0	Apparent	Nov-May	>60	---	High	High	High.
04A Freeburg	C	Rare	---	---	1.5-3.0	Perched	Nov-May	>60	---	High	High	High.
05B, 05C Hartville	C	None	---	---	1.5-3.0	Perched	Nov-Mar	>60	---	High	Moderate	Moderate.
06C2, 06D2 Bucklick	C	None	---	---	>6.0	---	---	40-60	Hard	Moderate	Moderate	Moderate.
07B, 07C, 07E2 Menfro	B	None	---	---	>6.0	---	---	>60	---	High	Low	Moderate.
10F:												
Gasconade	D	None	---	---	>6.0	---	---	4-20	Hard	Moderate	High	Low.
Rock outcrop.												
11 Dockery	C	Frequent	Brief	Nov-Jun	2.0-3.0	Apparent	Nov-Apr	>60	---	High	Moderate	Low.
12 Bremer	C	Rare	---	---	1.0-2.0	Apparent	Nov-Apr	>60	---	High	Moderate	Moderate.
13A Auxvasse	D	Rare	---	---	1.0-2.0	Perched	Nov-May	>60	---	Moderate	High	High.
16 Waldron	D	Occasional	Long	Nov-May	1.0-3.0	Apparent	Nov-May	>60	---	High	High	Low.
17D Wilderness	C	None	---	---	1.0-2.0	Perched	Nov-May	>60	---	Moderate	Moderate	High.
19 Haynie	B	Occasional	Long	Nov-May	>6.0	---	---	>60	---	High	Low	Low.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
20----------------- Sarpy	A	Frequent----	Long------	Nov-Jun	>6.0	---	---	>60	---	Low------	Low------	Low.
23F:												
Weingarten--------	C	None--------	---	---	2.5-4.0	Perched	Nov-Apr	>60	---	Moderate	Moderate	Moderate.
Gatewood---------	C	None--------	---	---	1.5-3.0	Perched	Nov-Apr	20-40	Hard	Moderate	High-----	Moderate.
24F---------------- Gatewood	C	None--------	---	---	1.5-3.0	Perched	Nov-Apr	20-40	Hard	Moderate	High-----	Moderate.
26D, 26F---------- Beemont	C	None--------	---	---	4.0-6.0	Perched	Nov-Apr	>60	---	Moderate	High-----	High.
28C, 28D2, 28E2--- Weingarten	C	None--------	---	---	2.5-4.0	Perched	Nov-Apr	>60	---	Moderate	Moderate	Moderate.
31D:												
Bucklick---------	C	None--------	---	---	>6.0	---	---	40-60	Hard	Moderate	Moderate	Moderate.
Beemont----------	C	None--------	---	---	4.0-6.0	Perched	Nov-Apr	>60	---	Moderate	High-----	High.
Moko-------------	D	None--------	---	---	>6.0	---	---	<10	Hard	Moderate	Low------	Low.
32. Pits												
35A, 35B---------- Glensted	D	None--------	---	---	0.5-1.5	Perched	Nov-May	>60	---	High-----	High-----	Moderate.
37---------------- Marion	D	None--------	---	---	1.0-2.0	Perched	Nov-May	>60	---	Moderate	High-----	High.
39---------------- Nolin	B	Frequent----	Brief-----	Nov-Jun	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
43---------------- Cedargap	B	Frequent----	Brief-----	Sep-May	>6.0	---	---	>60	---	Moderate	Low------	Low.
45---------------- Pope	B	Occasional	Brief-----	Nov-Apr	>6.0	---	---	>60	---	Moderate	Low------	High.
49A--------------- Gladden	B	Frequent----	Brief-----	Nov-May	>6.0	---	---	>60	---	Moderate	High-----	High.
51F:												
Beemont----------	C	None--------	---	---	4.0-6.0	Perched	Nov-May	40-60	Hard	Moderate	High-----	High.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
51F:												
Ramsey-----------	D	None---------	---	---	>6.0	---	---	7-20	Hard	Moderate	Low-------	Moderate.
Rock outcrop.												
60F:												
Gatewood---------	C	None---------	---	---	1.5-3.0	Perched	Jan-Apr	20-40	Hard	Moderate	High------	Moderate.
Menfro-----------	B	None---------	---	---	>6.0	---	---	>60	---	High------	Low-------	Moderate.

TABLE 19.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Auxvasse	Fine, montmorillonitic, mesic Aeric Albaqualfs
Beemont	Very fine, montmorillonitic, mesic Typic Hapludalfs
Bremer	Fine, montmorillonitic, mesic Typic Argiaquolls
Bucklick	Fine, mixed, mesic Typic Hapludalfs
Cedargap	Loamy-skeletal, mixed, mesic Cumulic Hapludolls
Coulstone	Loamy-skeletal, siliceous, mesic Typic Paleudults
Dockery	Fine-silty, mixed, nonacid, mesic Aquic Udifluvents
Freeburg	Fine-silty, mixed, mesic Aquic Hapludalfs
Gasconade	Clayey-skeletal, mixed, mesic Lithic Hapludolls
Gatewood	Very fine, mixed, mesic Typic Hapludalfs
Gladden	Coarse-loamy, siliceous, mesic Dystric Fluventic Eutrochrepts
Glensted	Fine, montmorillonitic, mesic Mollic Albaqualfs
Hartville	Fine, mixed, mesic Aquic Hapludalfs
Haynie	Coarse-silty, mixed (calcareous), mesic Mollic Udifluvents
Marion	Fine, montmorillonitic, mesic Albaquic Hapludalfs
Menfro	Fine-silty, mixed, mesic Typic Hapludalfs
Moko	Loamy-skeletal, mixed, mesic Lithic Hapludolls
Nolin	Fine-silty, mixed, mesic Dystric Fluventic Eutrochrepts
Pope	Coarse-loamy, mixed, mesic Fluventic Dystrochrepts
Racoon	Fine-silty, mixed, mesic Typic Ochraqualfs
Ramsey	Loamy, siliceous, mesic Lithic Dystrochrepts
Sarpy	Mixed, mesic Typic Udipsamments
Union	Fine, mixed, mesic Typic Fragiudalfs
Waldron	Fine, montmorillonitic (calcareous), mesic Aeric Fluvaquents
Weingarten	Fine-silty, mixed, mesic Typic Hapludalfs
Wilderness	Loamy-skeletal, siliceous, mesic Typic Fragiudalfs

☆ U.S. GOVERNMENT PRINTING OFFICE : 1997—417-265/60506/NRCS

Accessibility Statement

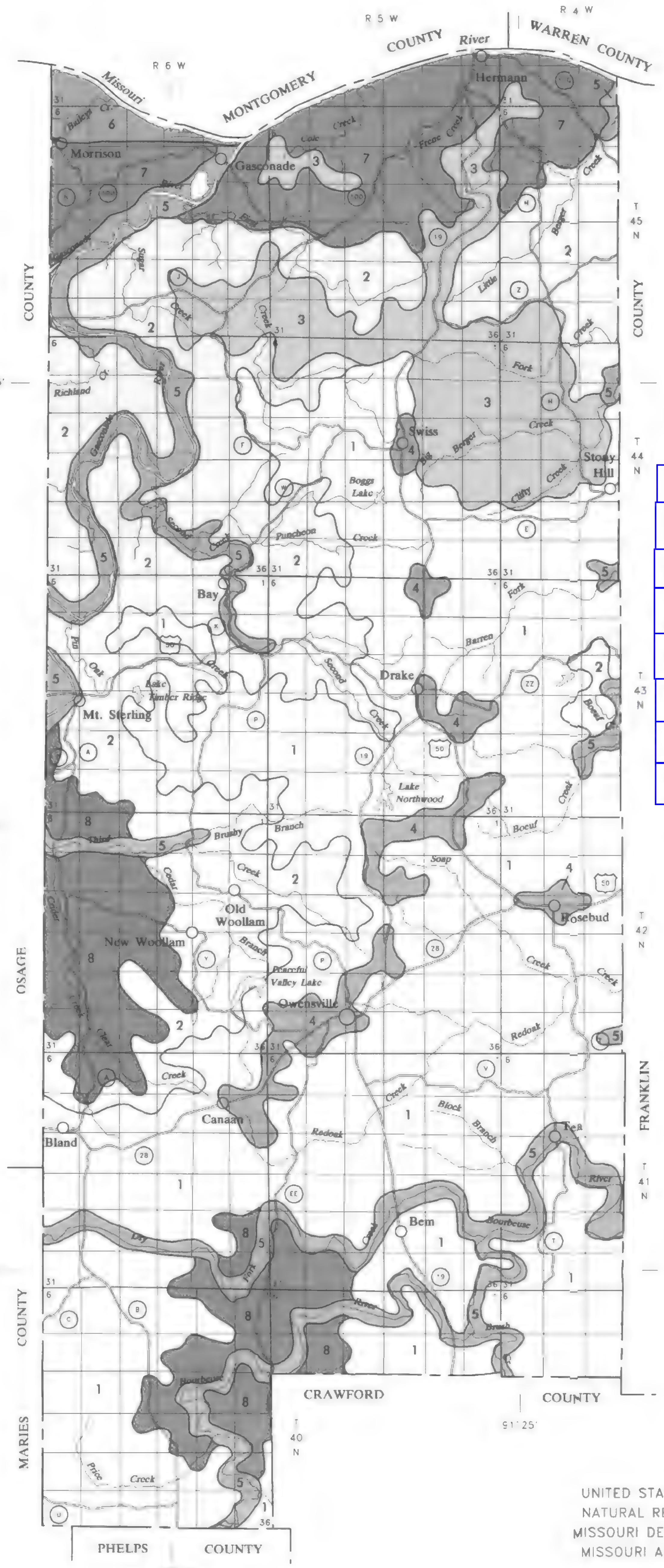
This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Index Map

Welcome Page

Manuscript

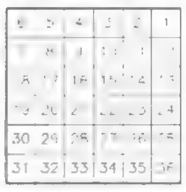


SOIL LEGEND*

1	BEEMONT–UNION ASSOCIATION
2	WEINGARTEN–GATEWOOD–GASCONADE ASSOCIATION
3	BEEMONT–WEINGARTEN ASSOCIATION
4	GLENSTED ASSOCIATION
5	NOLIN–RACOON–POPE ASSOCIATION
6	WALDRON–HAYNIE ASSOCIATION
7	MENFRO–GATEWOOD ASSOCIATION
8	COULSTONE–UNION ASSOCIATION

* The units on this legend are described in the text under the heading "General Soil Map Units."

SECTIONALIZED TOWNSHIP



UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI AGRICULTURAL EXPERIMENT STATION

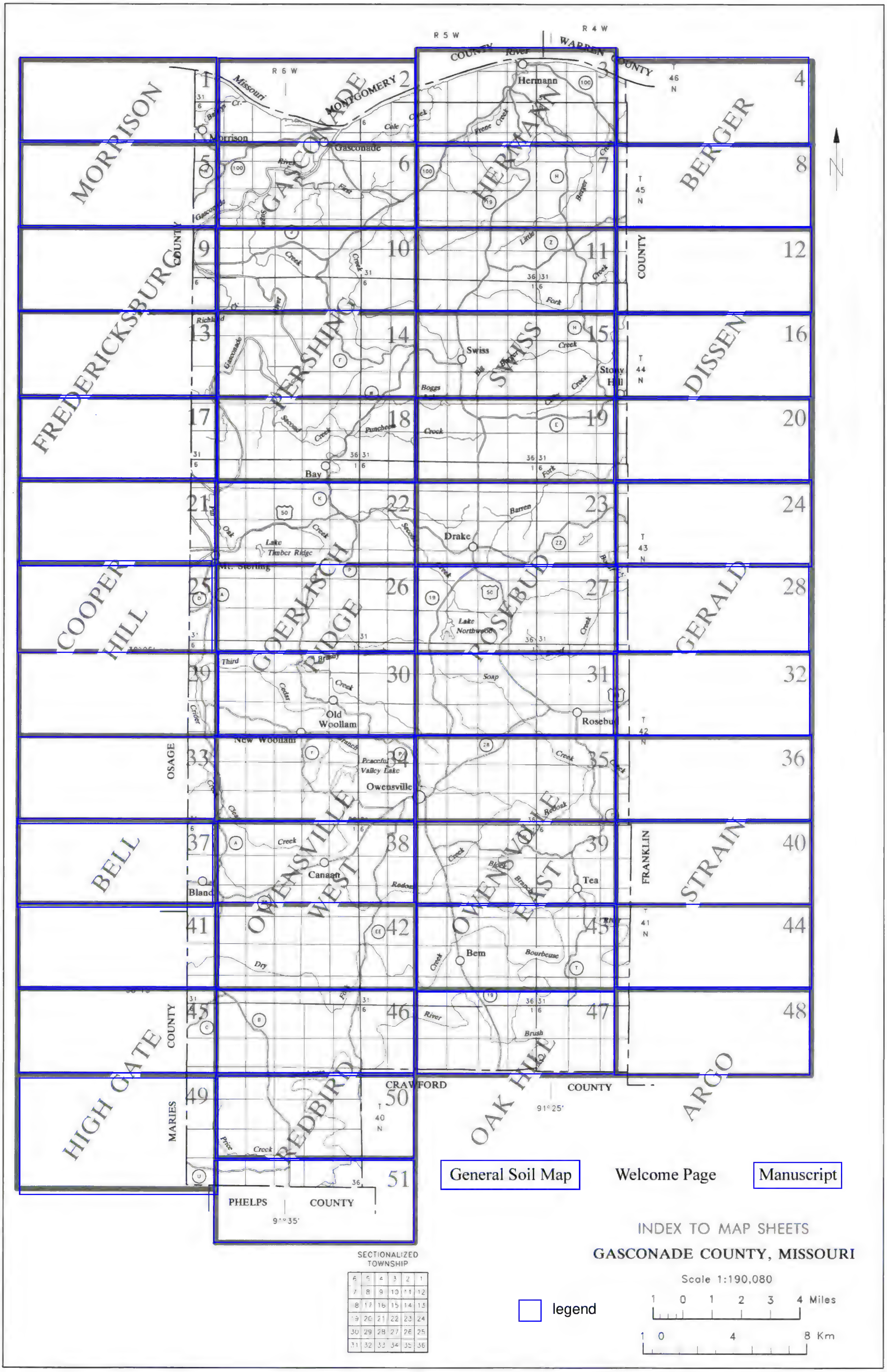
GENERAL SOIL MAP
GASCONADE COUNTY, MISSOURI

Scale 1:190,080

1 0 1 2 3 4 Miles

1 0 4 8 Km

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS
GASCONADE COUNTY, MISSOURI
Scale 1:190,080
1 0 1 2 3 4 Miles
1 0 4 8 Km
SECTIONALIZED TOWNSHIP
legend
General Soil Map
Welcome Page
Manuscript
MORRISON
GASCONADE
HERMANN
BERGER
FREDERICKSBURG
PERSHING
SWISS
DISSEN
COOPER HILL
GOERLISCH RIDGE
ROSEBUD
GERALD
BELL
OWENSVILLE WEST
OWENSVILLE EAST
STRAIN
HIGH GATE
REDBIRD
OAK HILL
ARGO
MONTGOMERY
WARREN COUNTY
FRANKLIN COUNTY
CRAWFORD COUNTY
PHELPS COUNTY
MARIES COUNTY
OSAGE COUNTY
Missouri River
Hermann
Morrison
Gasconade
Swiss
Stony Hill
Bay
Drake
Mt. Sterling
Lake Northwood
Old Woollam
New Woollam
Rosebud
Owensville
Canaan
Bland
Tea
Bem
R 6 W
R 5 W
R 4 W
T 46 N
T 45 N
T 44 N
T 43 N
T 42 N
T 41 N
T 40 N
91°25'
91°35'
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51

SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and a letter. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas.

SYMBOL	NAME
01B	Union silt loam, 2 to 5 percent slopes
01C	Union silt loam, 5 to 9 percent slopes
01C2	Union silt loam, 5 to 9 percent slopes, eroded
01D2	Union silt loam, 9 to 14 percent slopes, eroded
02F	Coulstone gravelly fine sandy loam, 14 to 35 percent slopes
03A	Racoon silt loam, 0 to 3 percent slopes, rarely flooded
04A	Freeburg silt loam, 0 to 3 percent slopes, rarely flooded
05B	Hartville silt loam, 2 to 5 percent slopes
05C	Hartville silt loam, 5 to 9 percent slopes
06C2	Bucklick silt loam, 5 to 9 percent slopes, eroded
06D2	Bucklick silt loam, 9 to 14 percent slopes, eroded
07B	Menfro silt loam, 2 to 5 percent slopes
07C	Menfro silt loam, 5 to 9 percent slopes
07E2	Menfro silt loam, 14 to 20 percent slopes, eroded
10F	Gasconade-Rock outcrop complex, 14 to 35 percent slopes
11	Dockery silt loam, frequently flooded
12	Bremer silty clay loam, rarely flooded
13A	Auxvasse silt loam, 0 to 3 percent slopes, rarely flooded
16	Waldron silty clay, occasionally flooded
17D	Wilderness gravelly silt loam, 9 to 14 percent slopes
19	Haynie very fine sandy loam, occasionally flooded
20	Sarpy fine sand, frequently flooded
23F	Weingarten-Gatewood complex, 20 to 35 percent slopes
24F	Gatewood gravelly silt loam, 14 to 35 percent slopes
26D	Beemont gravelly silt loam, 5 to 14 percent slopes
26F	Beemont gravelly silt loam, 14 to 35 percent slopes
28C	Weingarten silt loam, 5 to 9 percent slopes
28D2	Weingarten silt loam, 9 to 14 percent slopes, eroded
28E2	Weingarten silt loam, 14 to 20 percent slopes, eroded
31D	Bucklick-Beemont-Moko complex, 5 to 14 percent slopes
32	Pits, quarries
35A	Glensted silt loam, 1 to 2 percent slopes
35B	Glensted silt loam, 2 to 5 percent slopes
37	Marion silt loam
39	Nolin silt loam, frequently flooded
43	Cedargap gravelly loam, frequently flooded
45	Pope fine sandy loam, occasionally flooded
49A	Gladden loam, 0 to 3 percent slopes, frequently flooded
51F	Beemont-Ramsey-Rock outcrop complex, 14 to 35 percent slopes
60F	Gatewood-Menfro complex, 20 to 35 percent slopes, bouldery

Index Map   Welcome Page   Manuscript

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state, or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline and neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK
1 890 000 FEET

LAND DIVISION CORNER
(sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE
(normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or Small
(Named where applicable)

PITS

- Gravel pit
- Mine or quarry 1 to 5 Acres

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban area) (occupied)
- Church
- School
- Indian mound (label)
- Located object (label) — Tower
- Tank (label) — Gas
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot 1 to 2 Acres

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — 26F 28D2

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

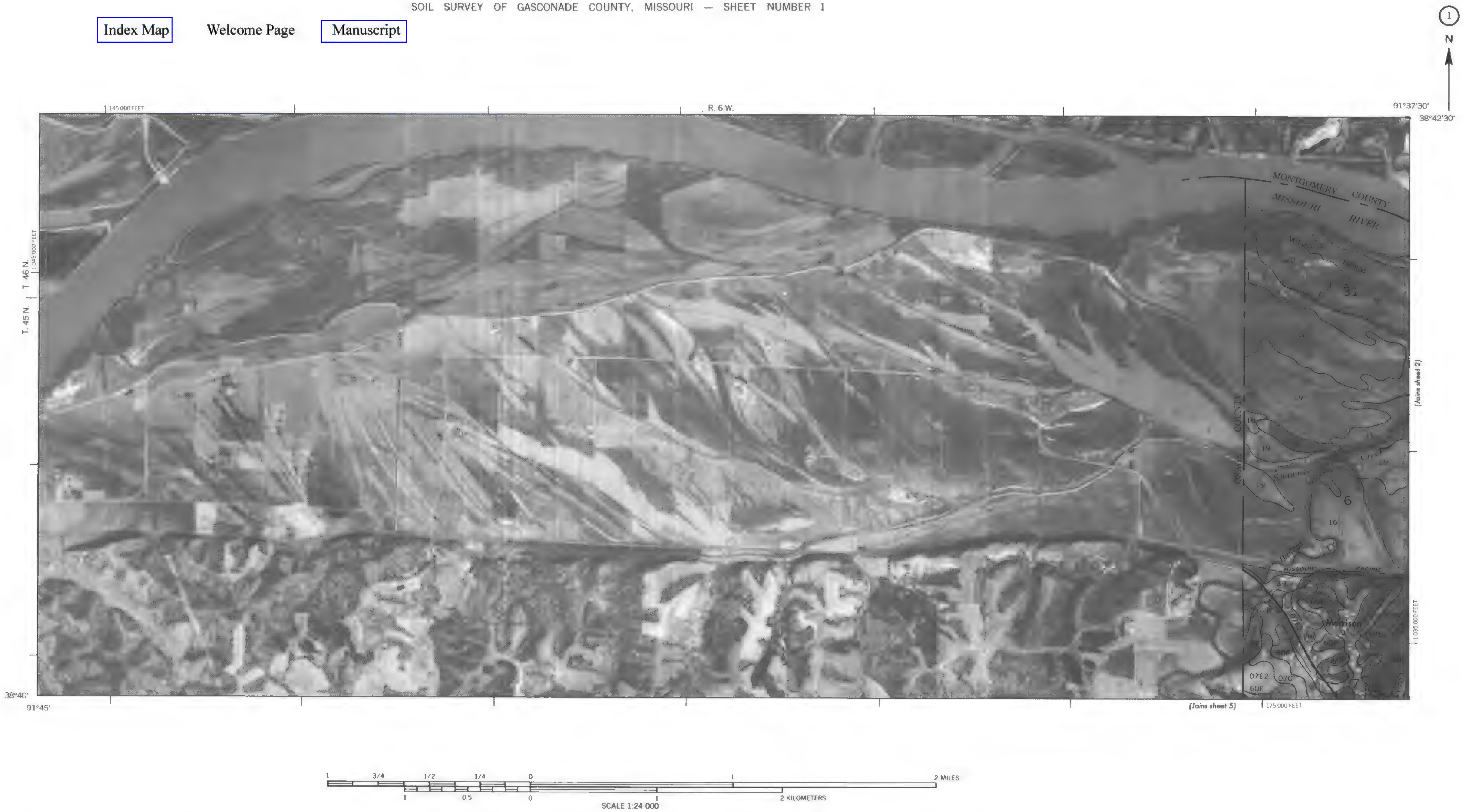
DEPRESSION OR SINK

SOIL SAMPLE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Clay pits 1 to 5 Acres

Index Map Welcome Page Manuscript



Index Map Welcome Page Manuscript

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

Index Map Welcome Page Manuscript


5
N
145 000 FEET
R. 6 W
(Joins sheet 1)
91°37'30"
38°40'
T. 45 N.
(Joins sheet 6)
OSAGE COUNTY
18
19
20
29
30
GASCONADE
RIVER
38°37'30"
91°45'
(Joins sheet 9)
175 000 FEET
2 MILES
2 KILOMETERS
SCALE 1:24 000

Index Map Welcome Page Manuscript

6

N

1 3/4 1/2 1/4 0 1 2 MILES

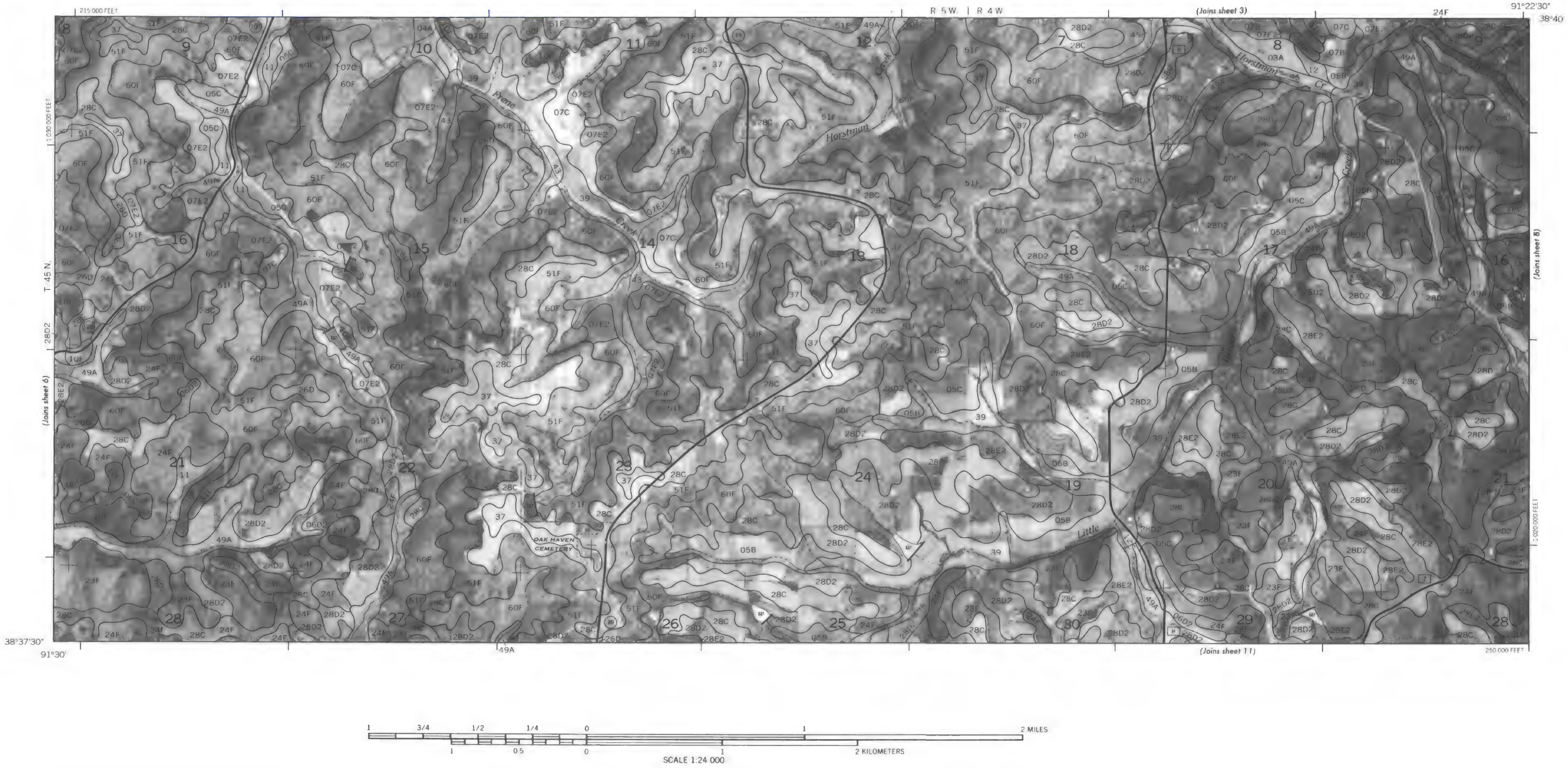
1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

Index Map

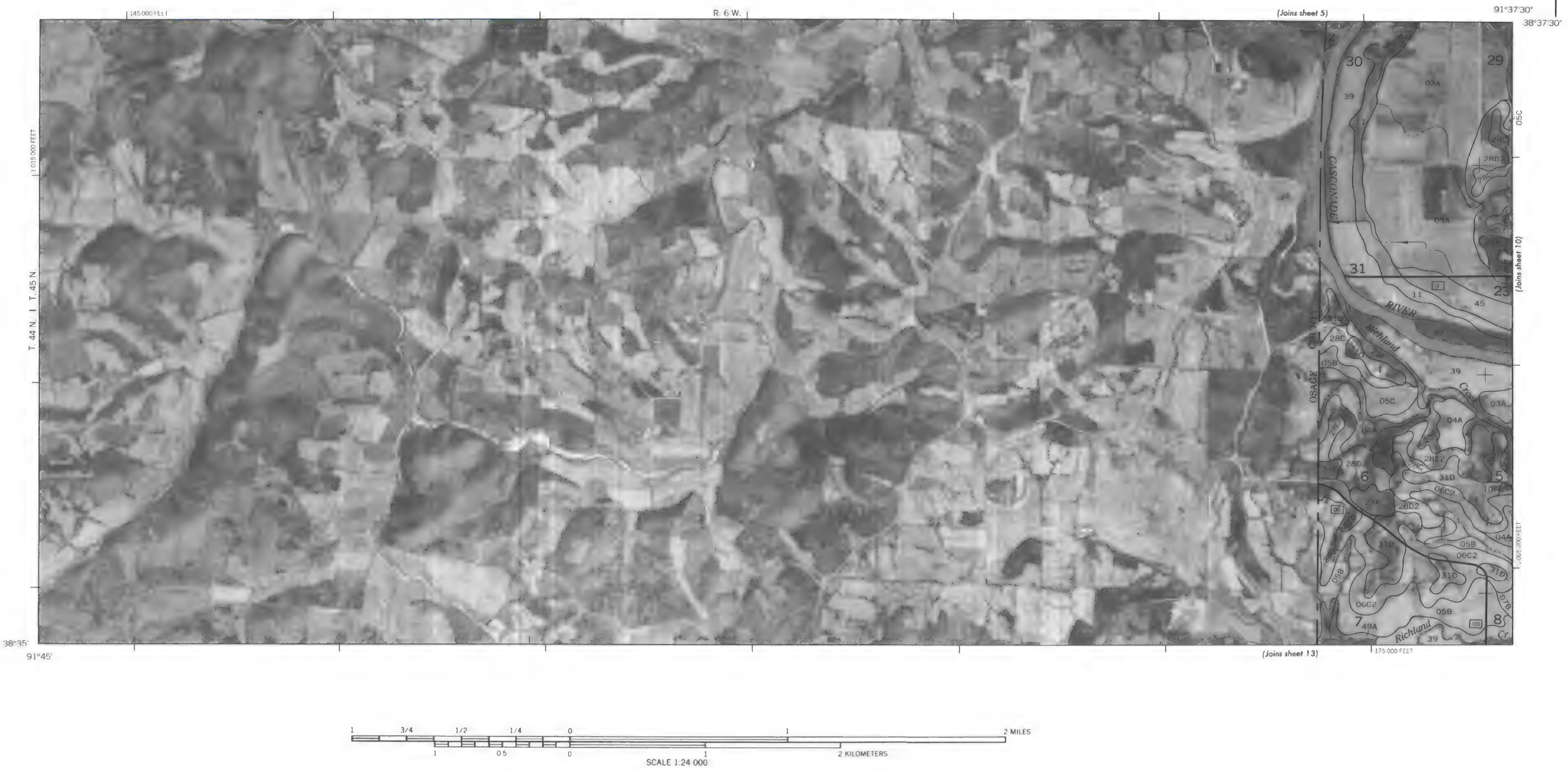
Welcome Page

Manuscript

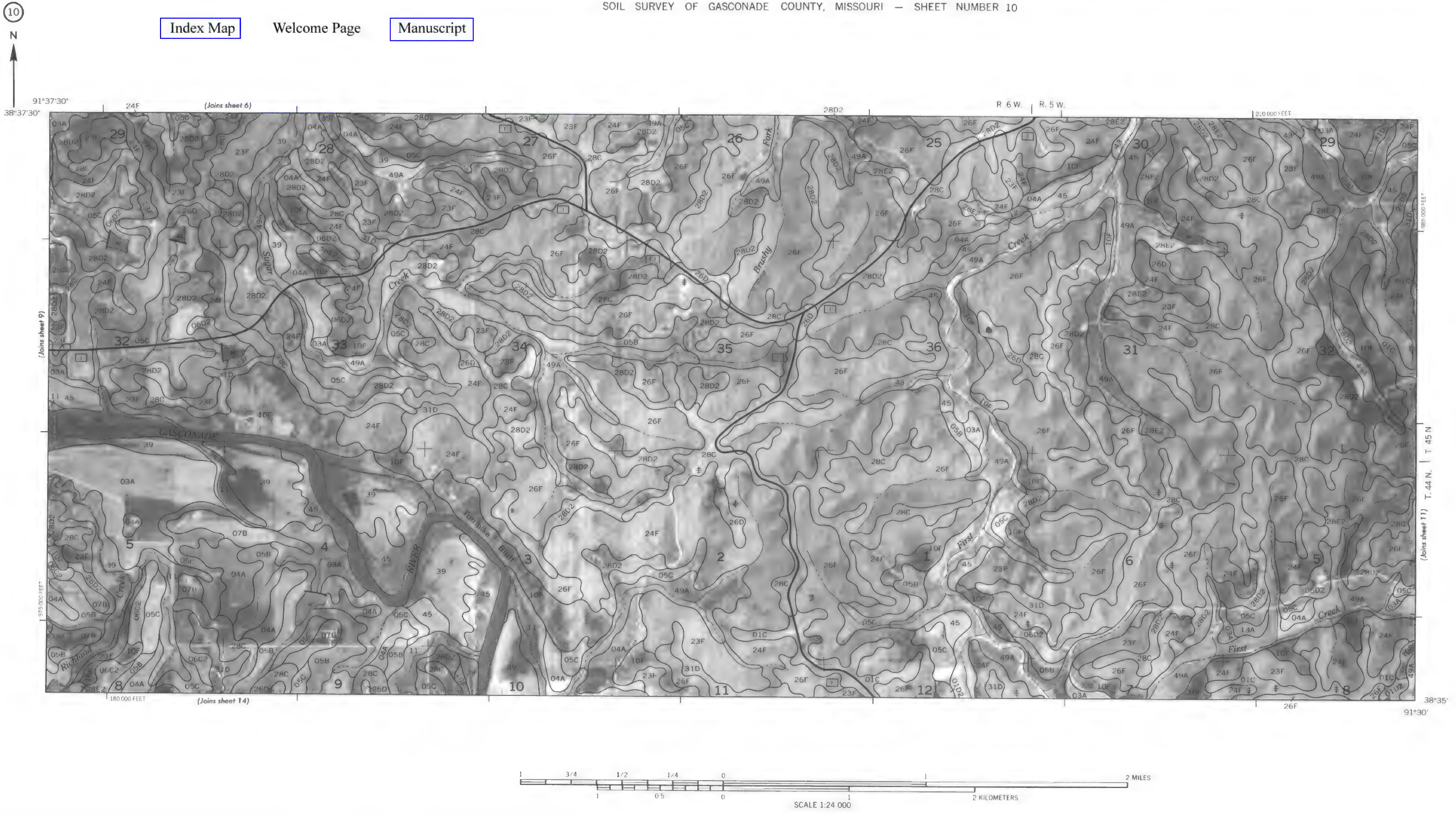


Index Map Welcome Page Manuscript

Index Map Welcome Page Manuscript



Index Map Welcome Page Manuscript



Index Map Welcome Page Manuscript

11

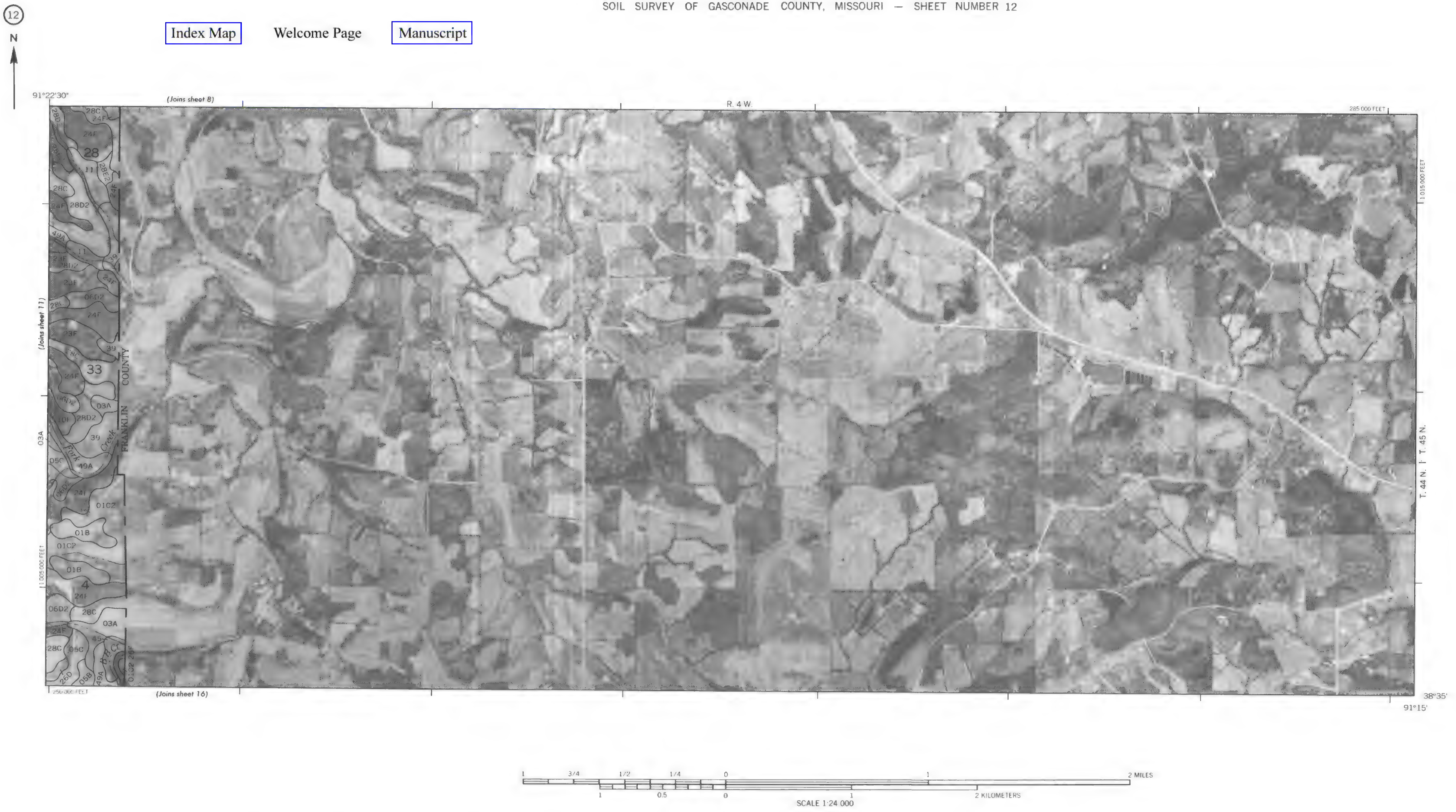
N

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

Index Map Welcome Page Manuscript

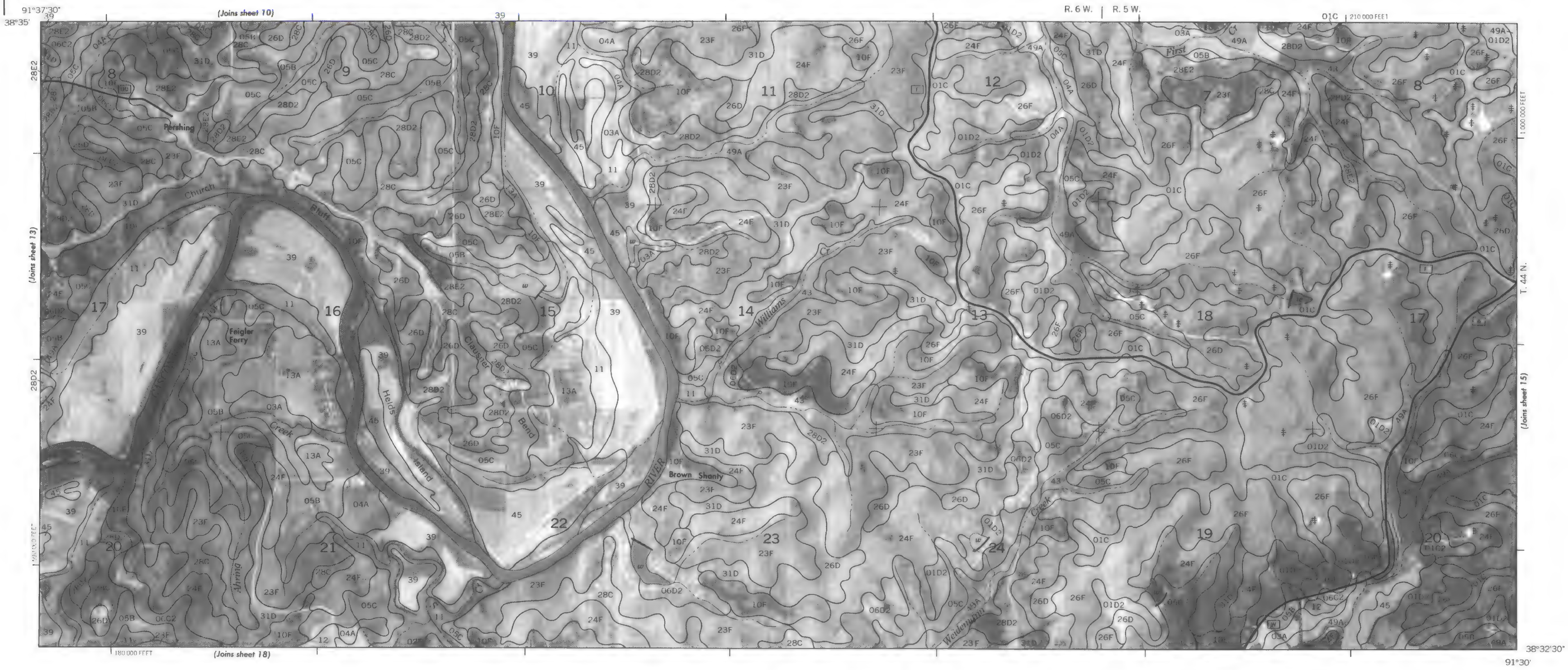


Index Map Welcome Page Manuscript

Index Map Welcome Page Manuscript

14

N

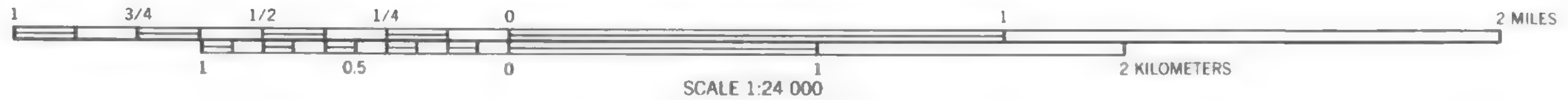


1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

Index Map Welcome Page Manuscript



Index Map Welcome Page Manuscript

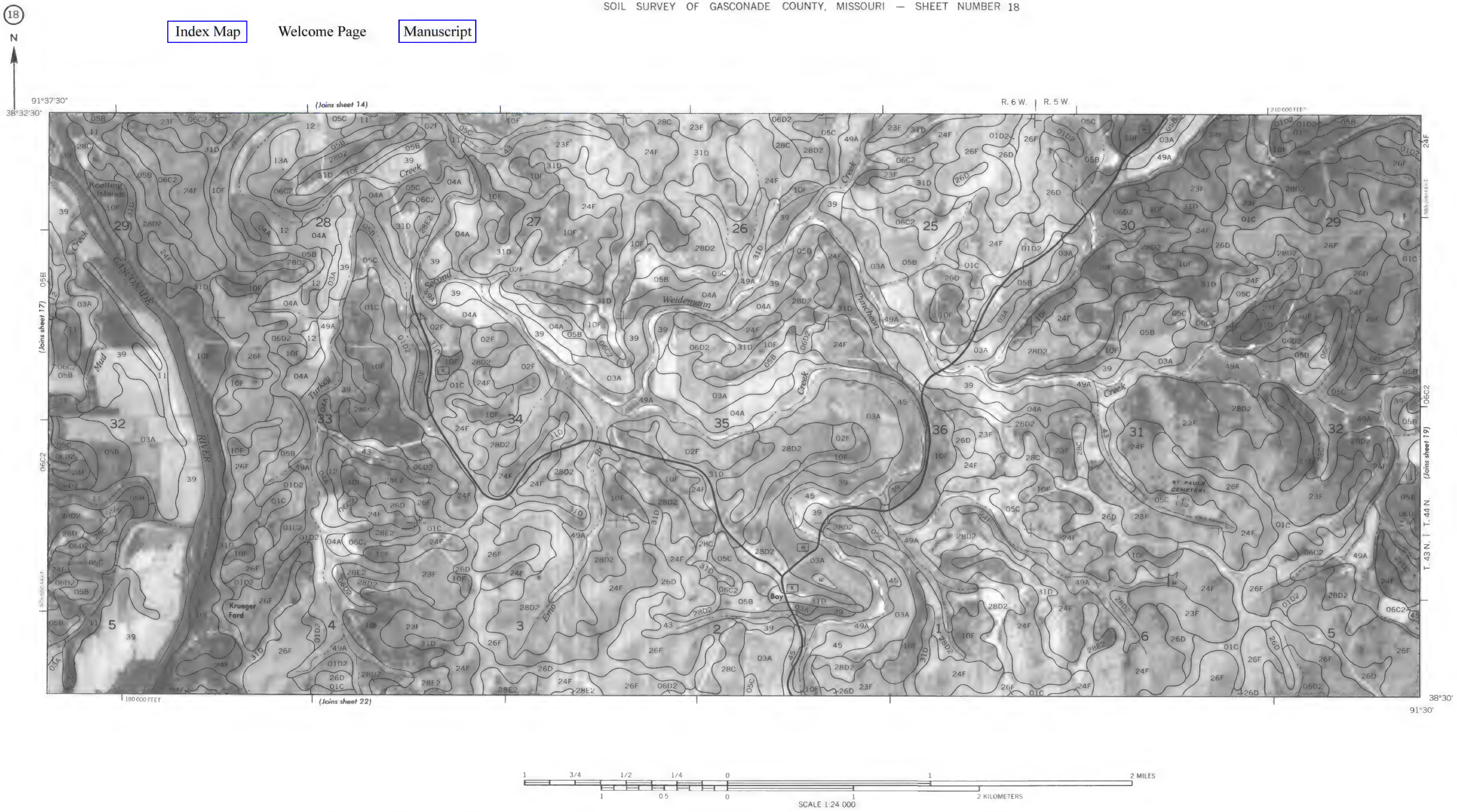
Index Map Welcome Page Manuscript

1 3/4 1/2 1/4 0 1 2 MILES

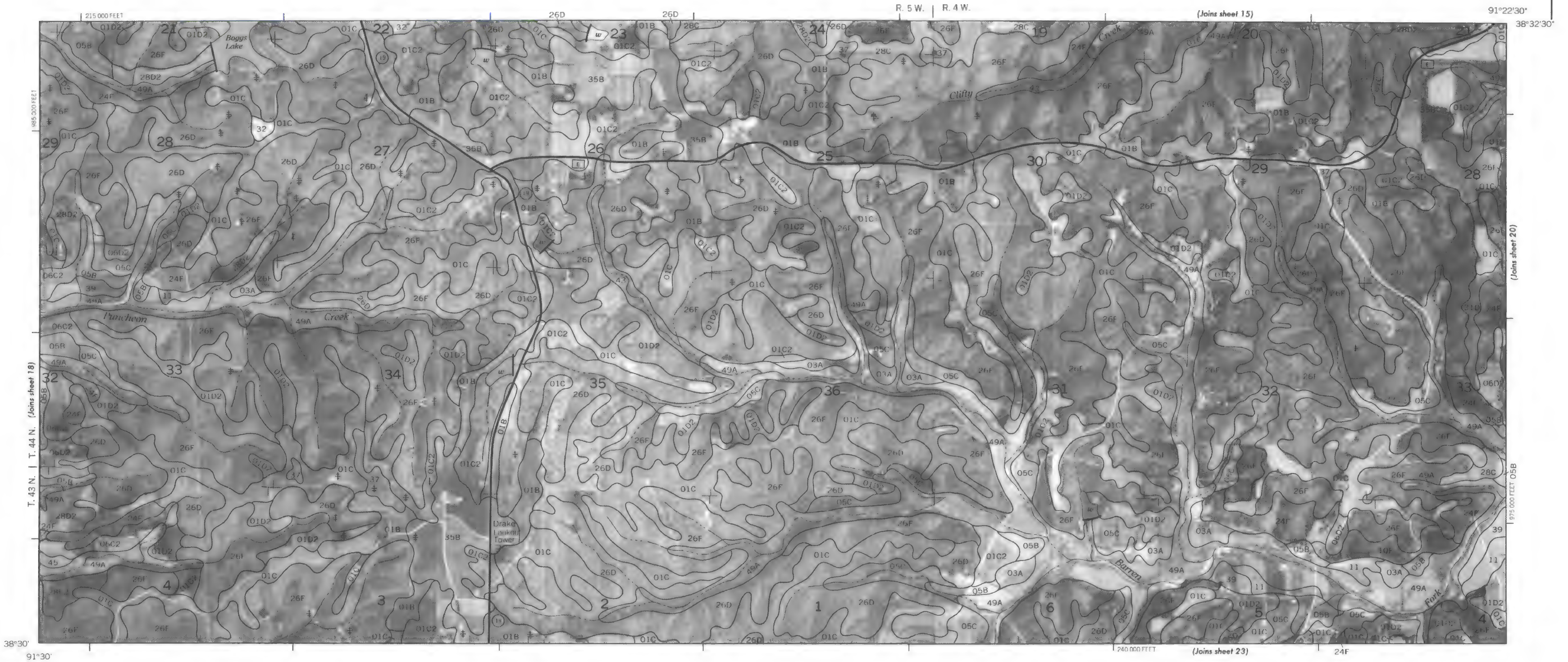
1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

Index Map Welcome Page Manuscript



Index Map   Welcome Page   Manuscript

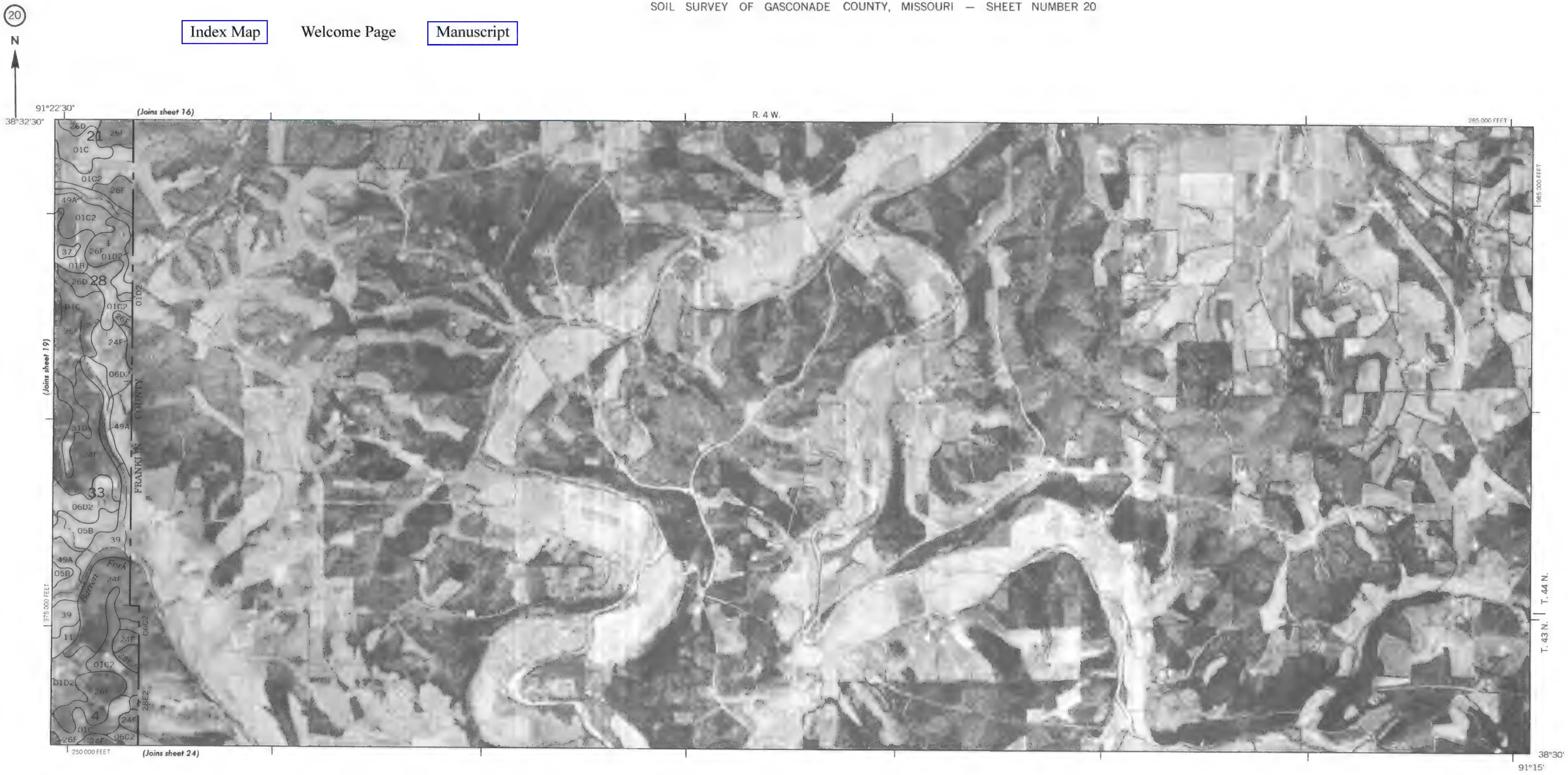


1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

Index Map Welcome Page Manuscript



1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

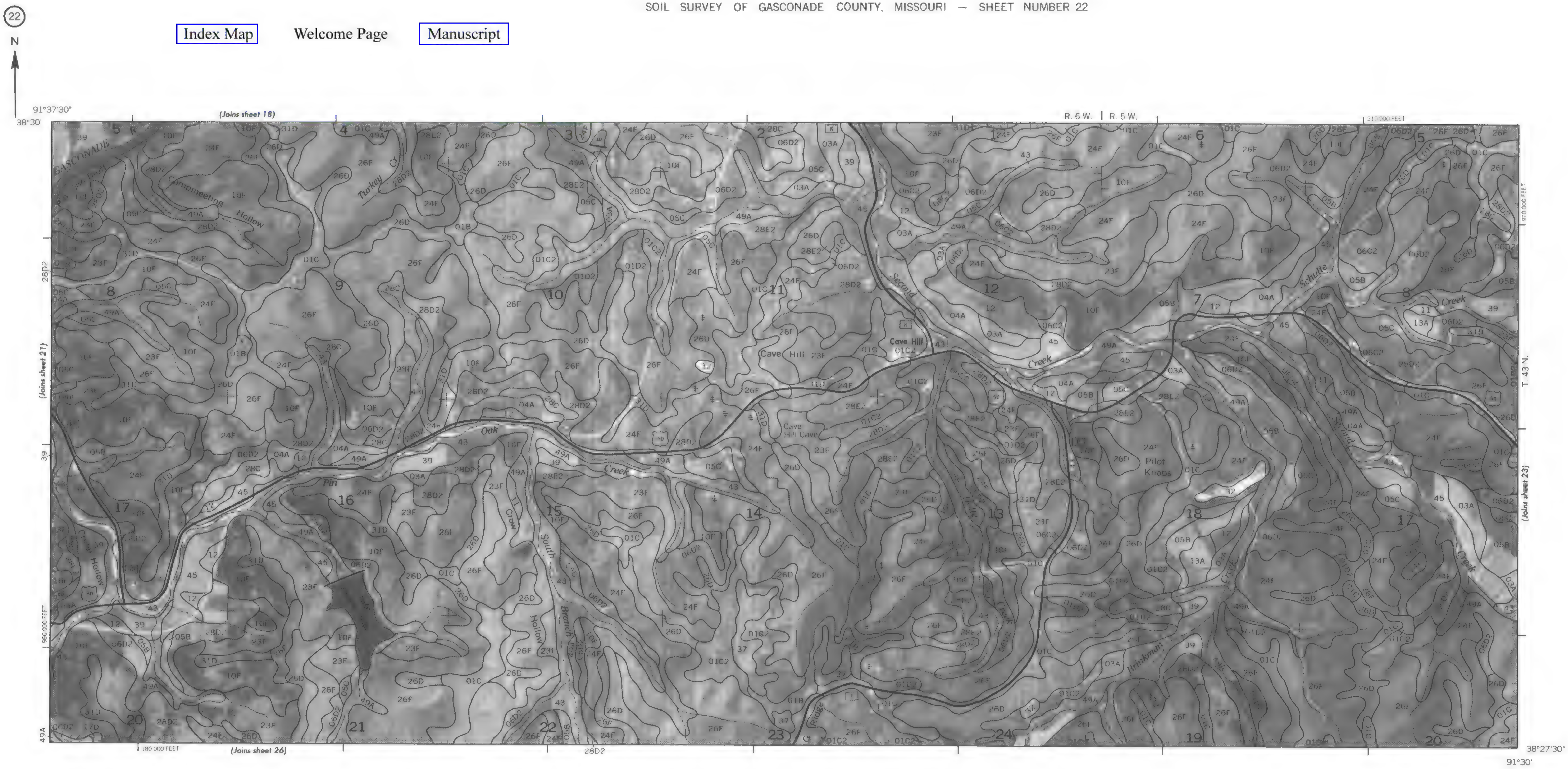
N

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

Index Map Welcome Page Manuscript

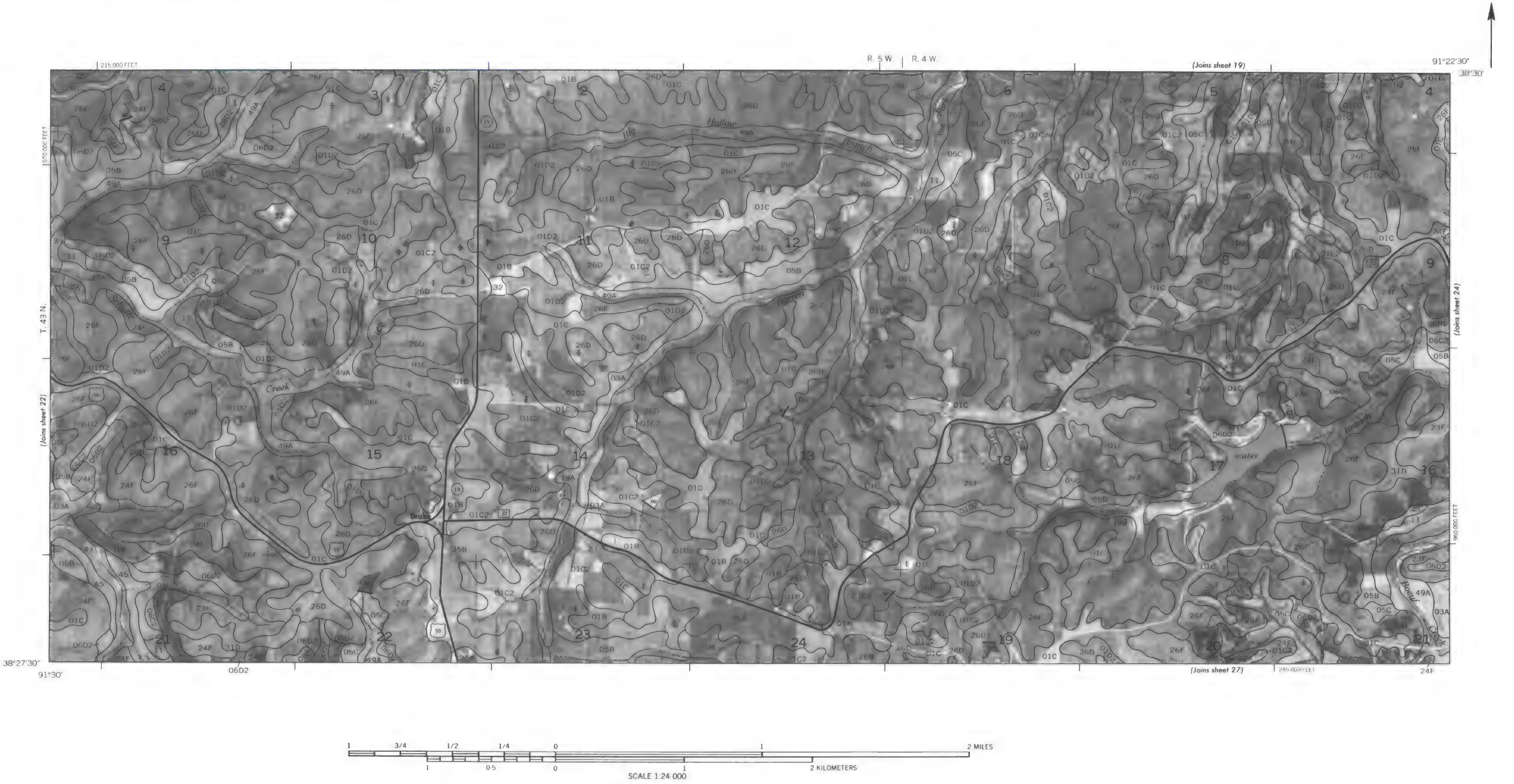


1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

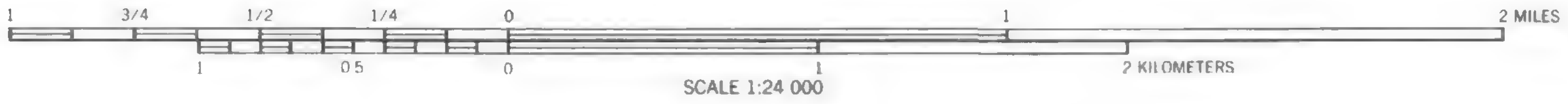
SCALE 1:24 000

Index Map   Welcome Page   Manuscript

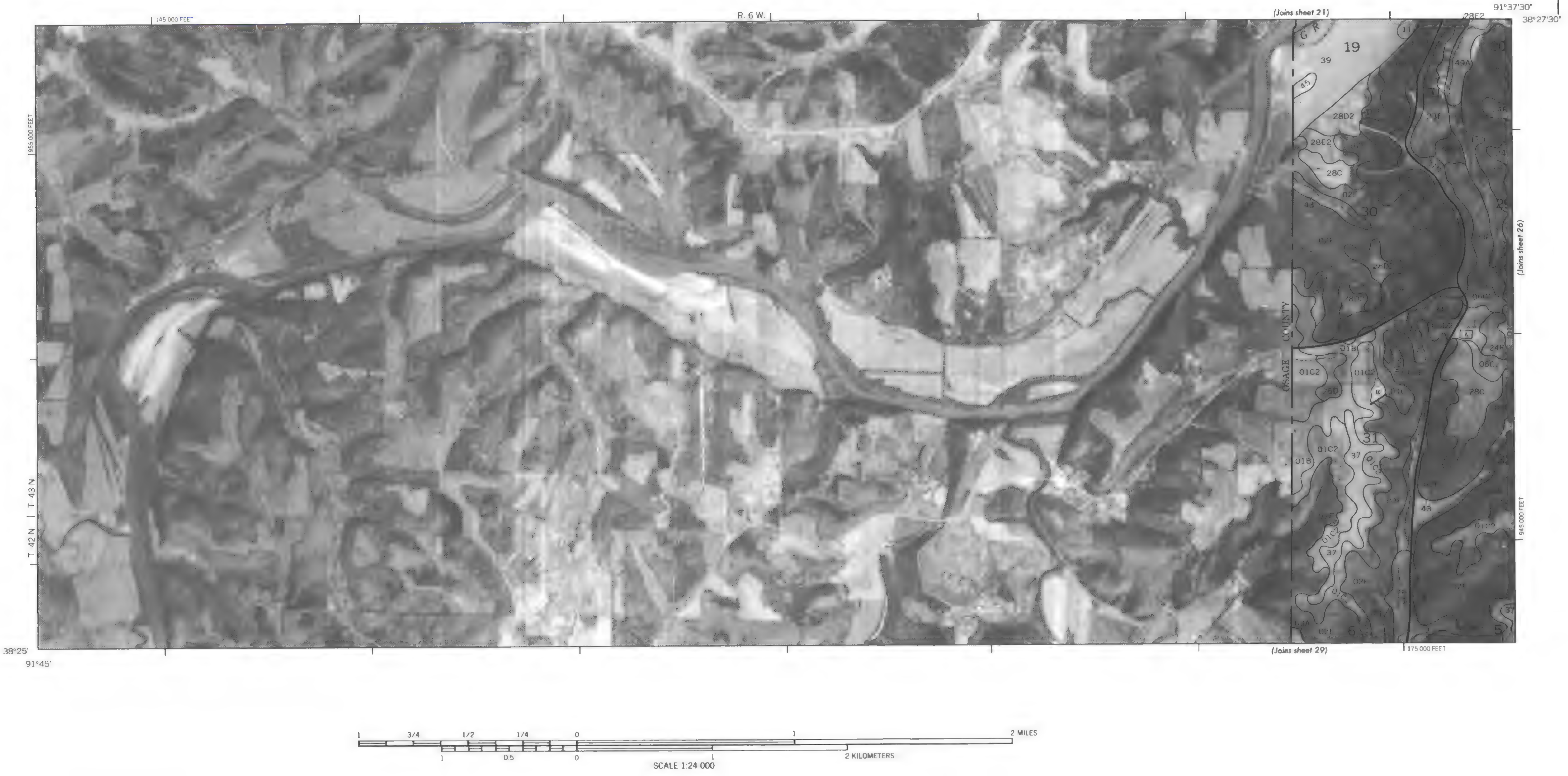


24

Index Map Welcome Page Manuscript

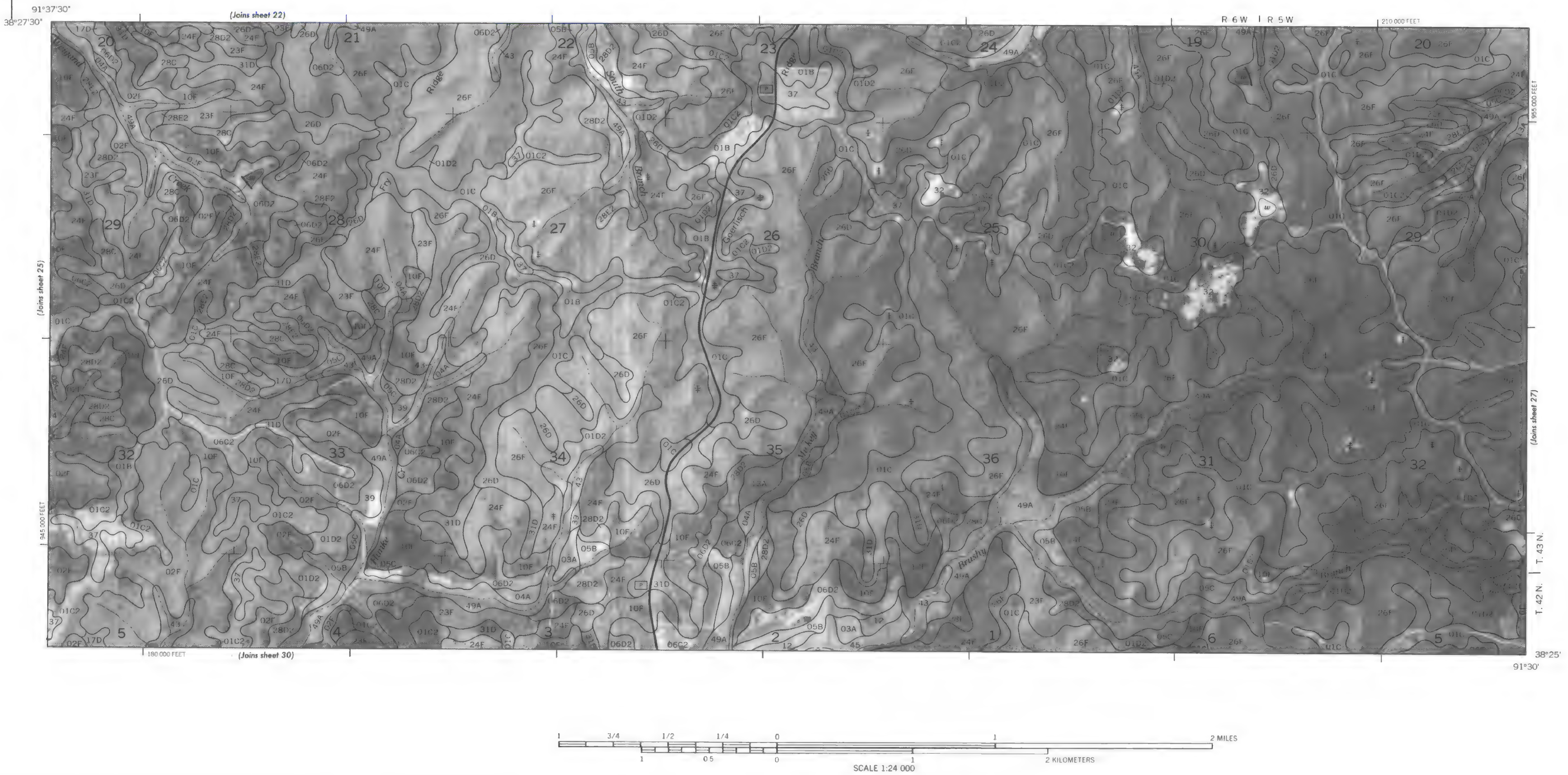


Index Map Welcome Page Manuscript

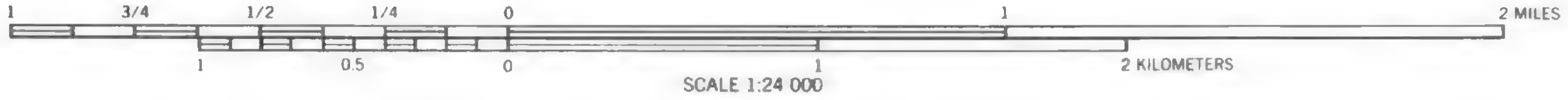


Index Map Welcome Page Manuscript

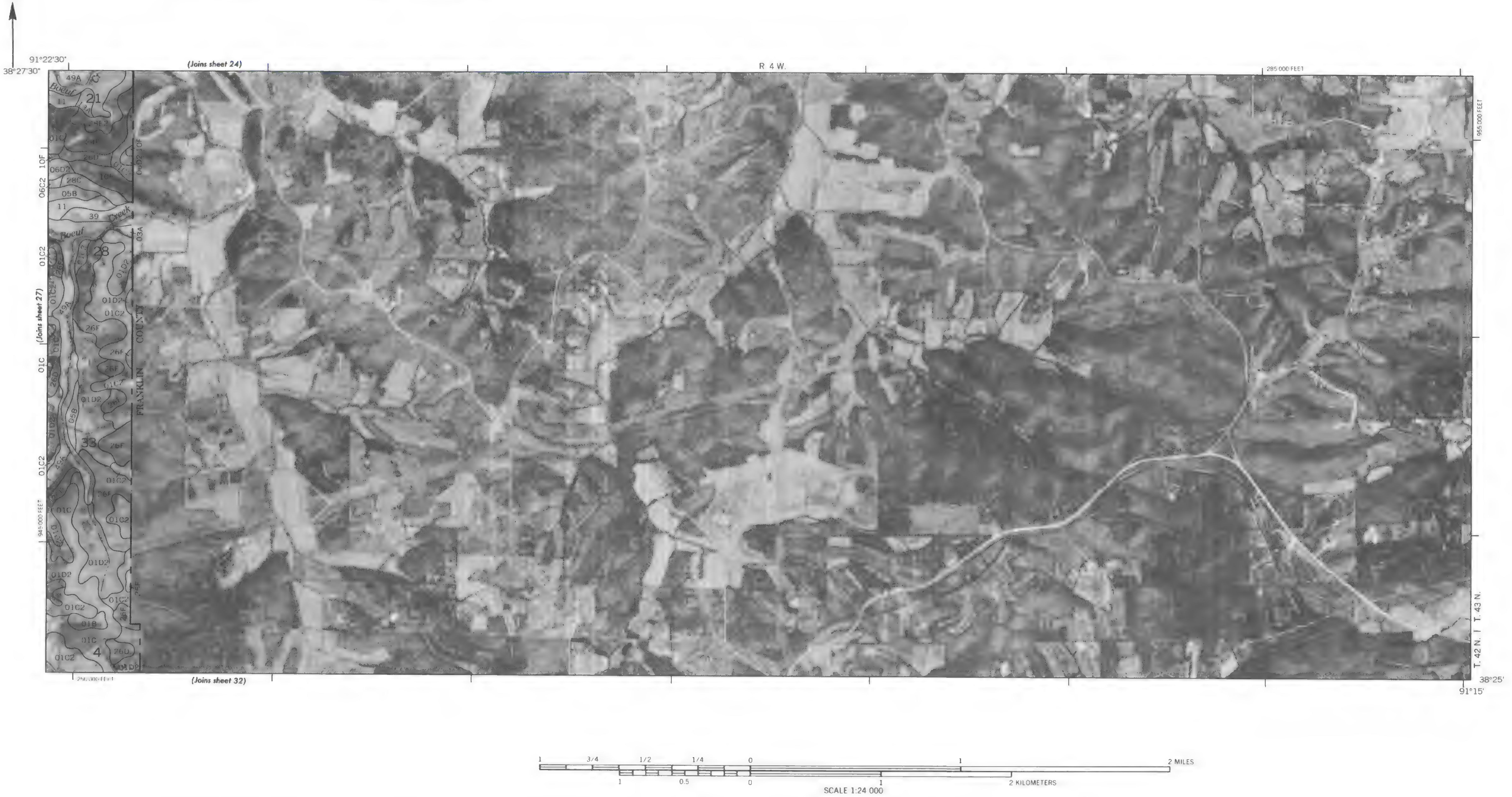
N

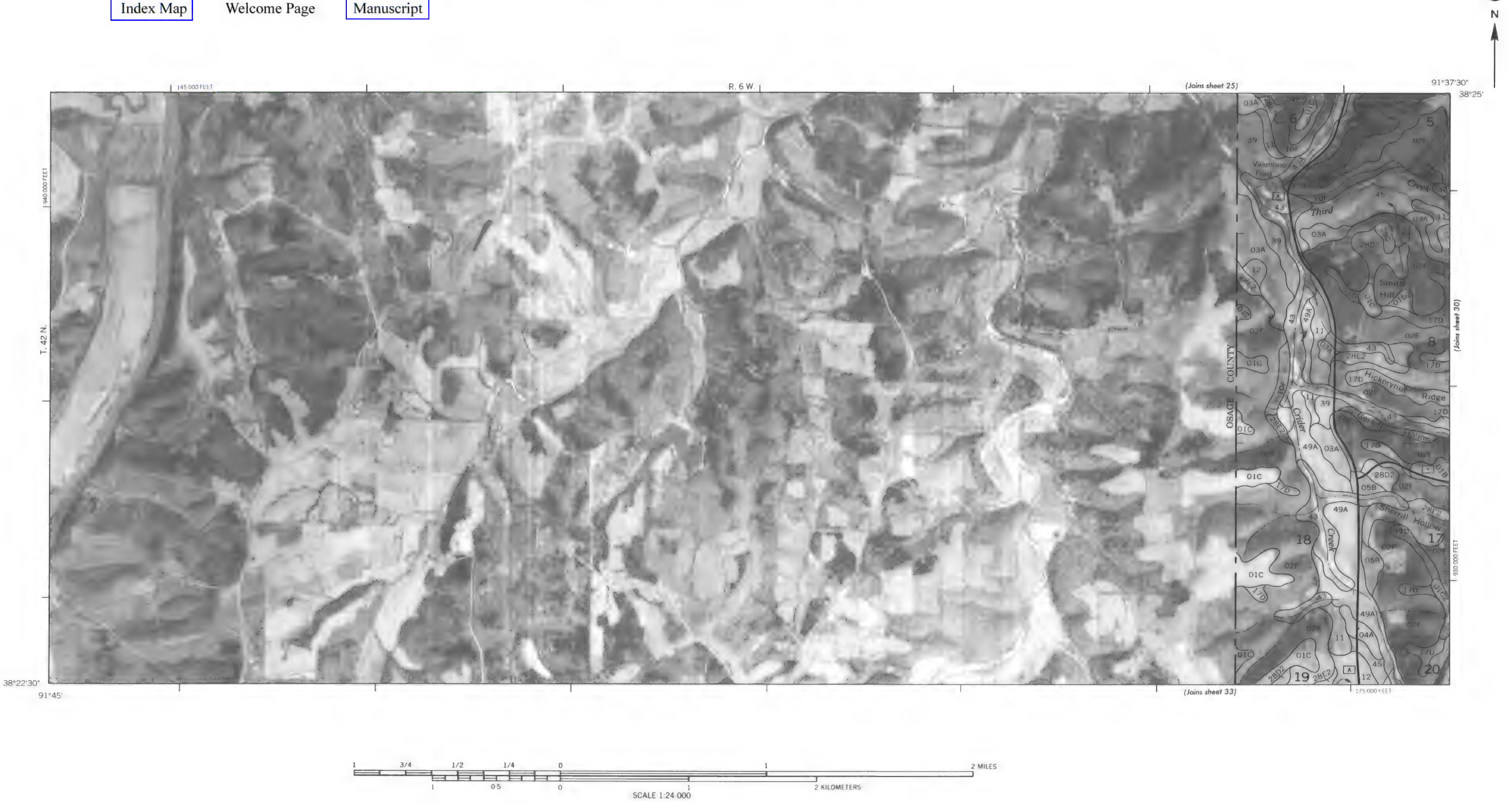


Index Map Welcome Page Manuscript

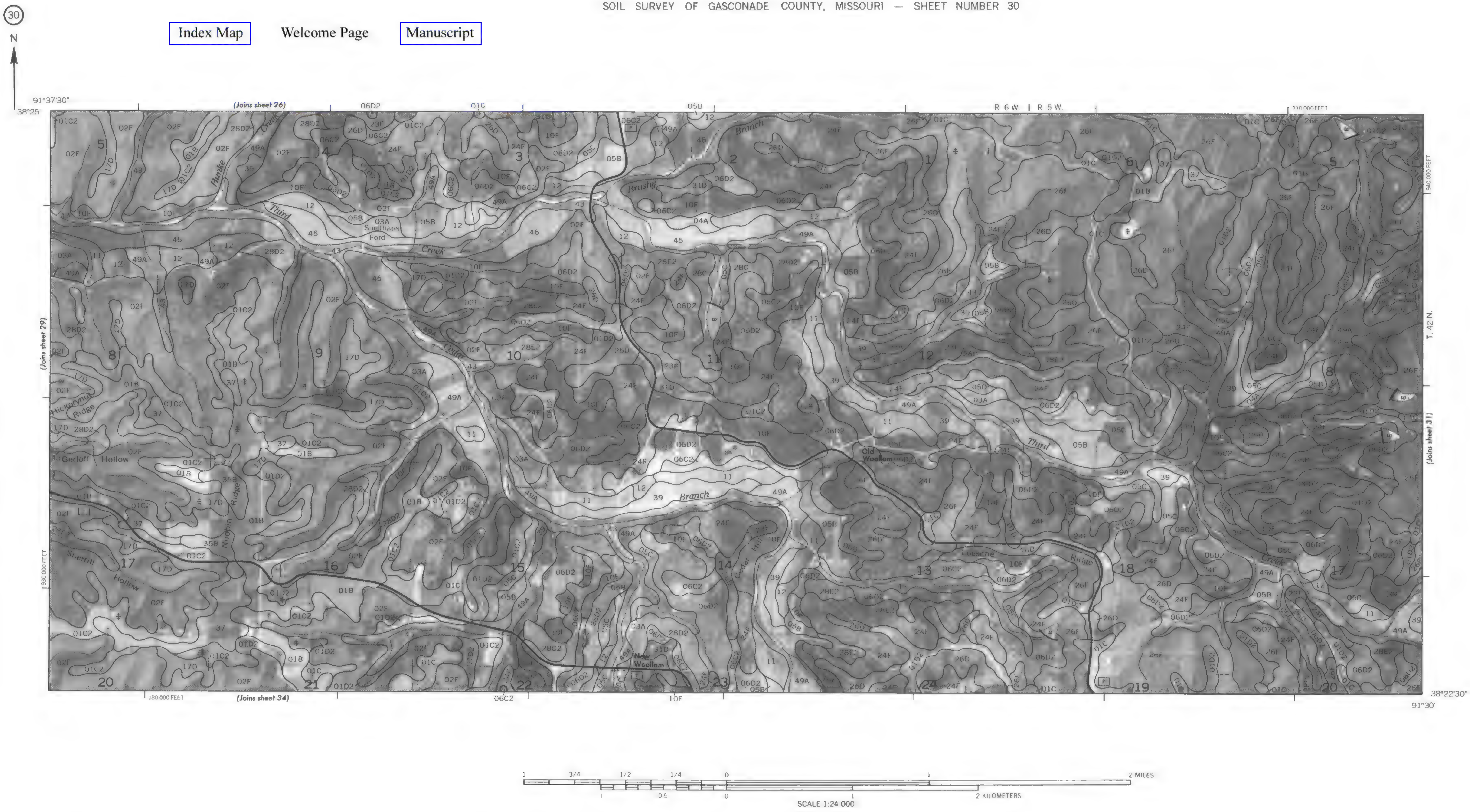


Index Map Welcome Page Manuscript




29
N
R. 6 W.
T. 42 N.
(Joins sheet 25)
(Joins sheet 30)
(Joins sheet 33)
91°37'30"
38°25'
38°22'30"
91°45'
145 000 FEET
940 000 FEET
930 000 FEET
175 000 FEET
OSAGE COUNTY
Valentine Ford
Third Creek
Smith Hill
Hickorynut Ridge
Crider Creek
Sherrill Hollow
2 MILES
2 KILOMETERS
SCALE 1:24 000

Index Map Welcome Page Manuscript



Index Map Welcome Page Manuscript

31

N

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

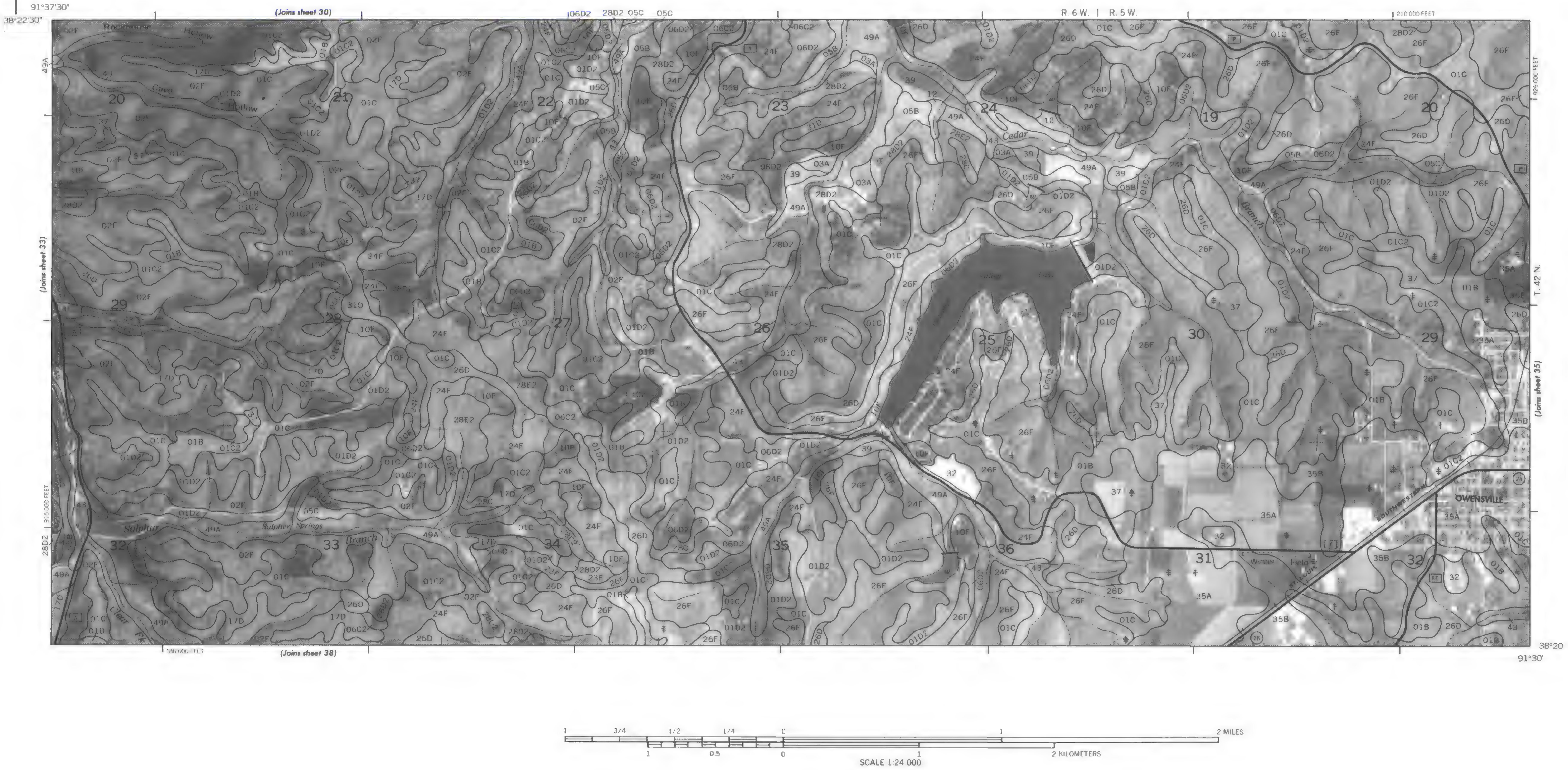
Index Map Welcome Page Manuscript

1 3/4 1/2 1/4 0 1 2 MILES

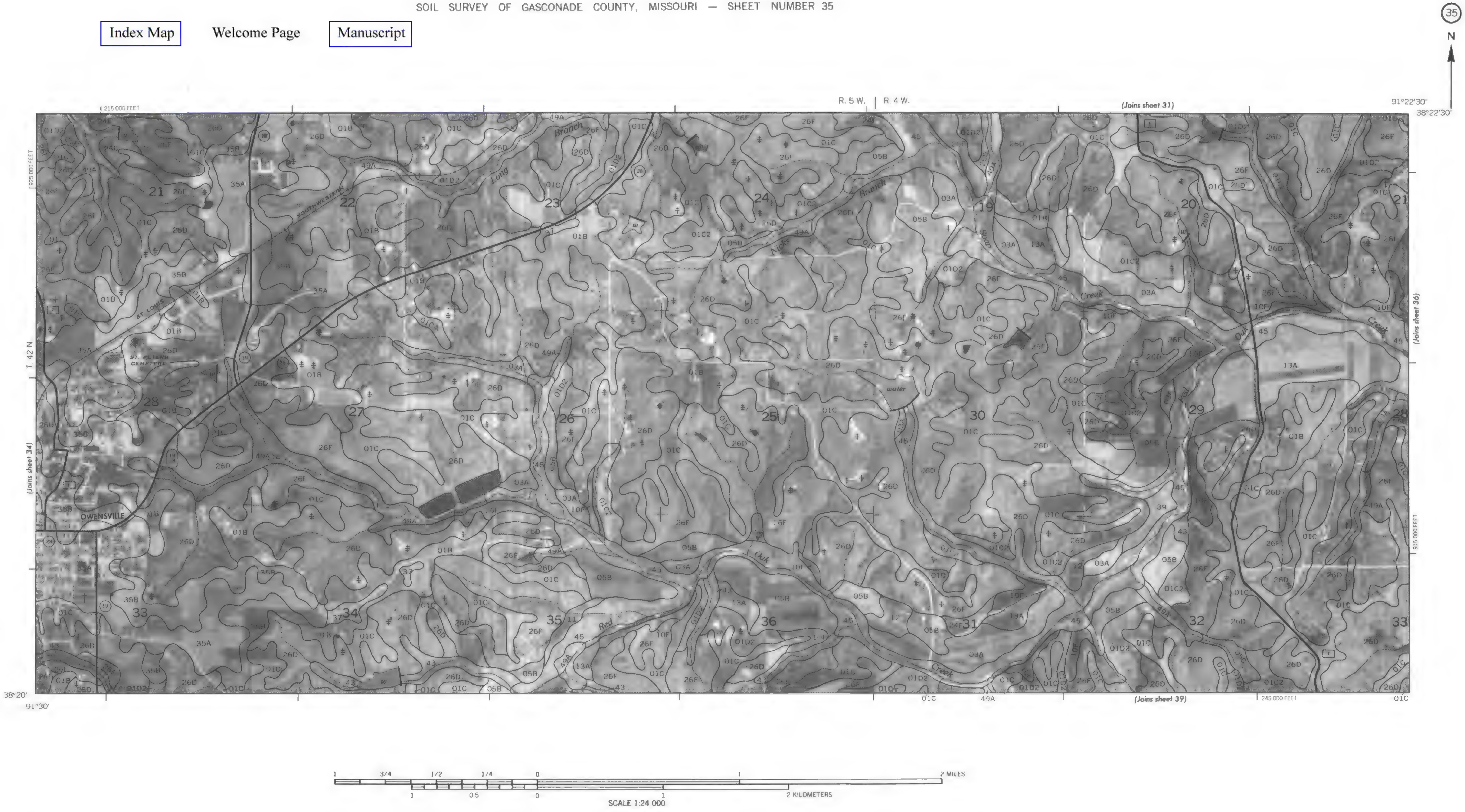
1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

Index Map Welcome Page Manuscript

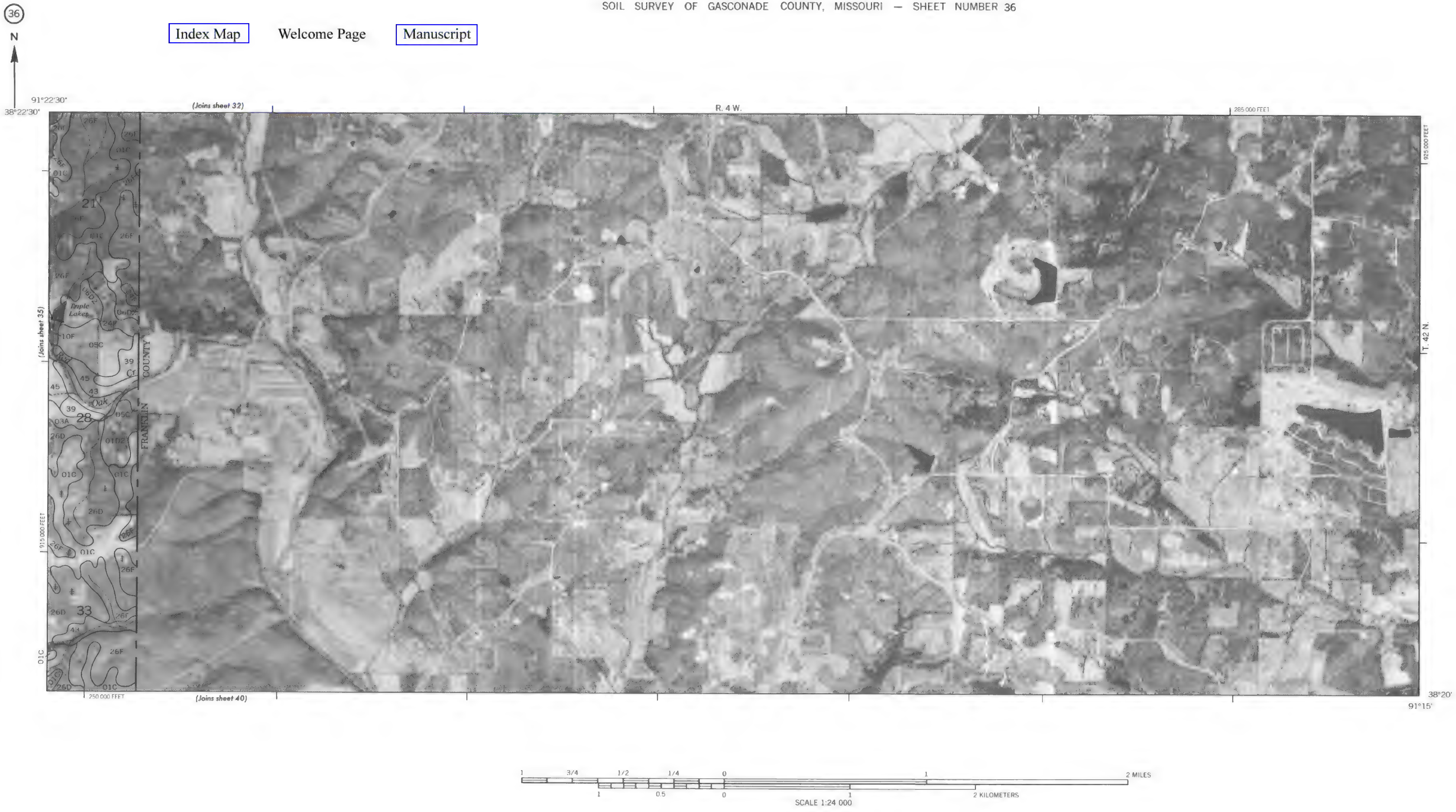


Index Map Welcome Page Manuscript



SCALE 1:24 000

Index Map Welcome Page Manuscript



37

1 3/4 1/2 1/4 0 1 2 MILES
1 0.5 0 1 2 KILOMETERS
SCALE 1:24 000

Index Map Welcome Page Manuscript

1 3/4 1/2 1/4 0 1 2 MILES

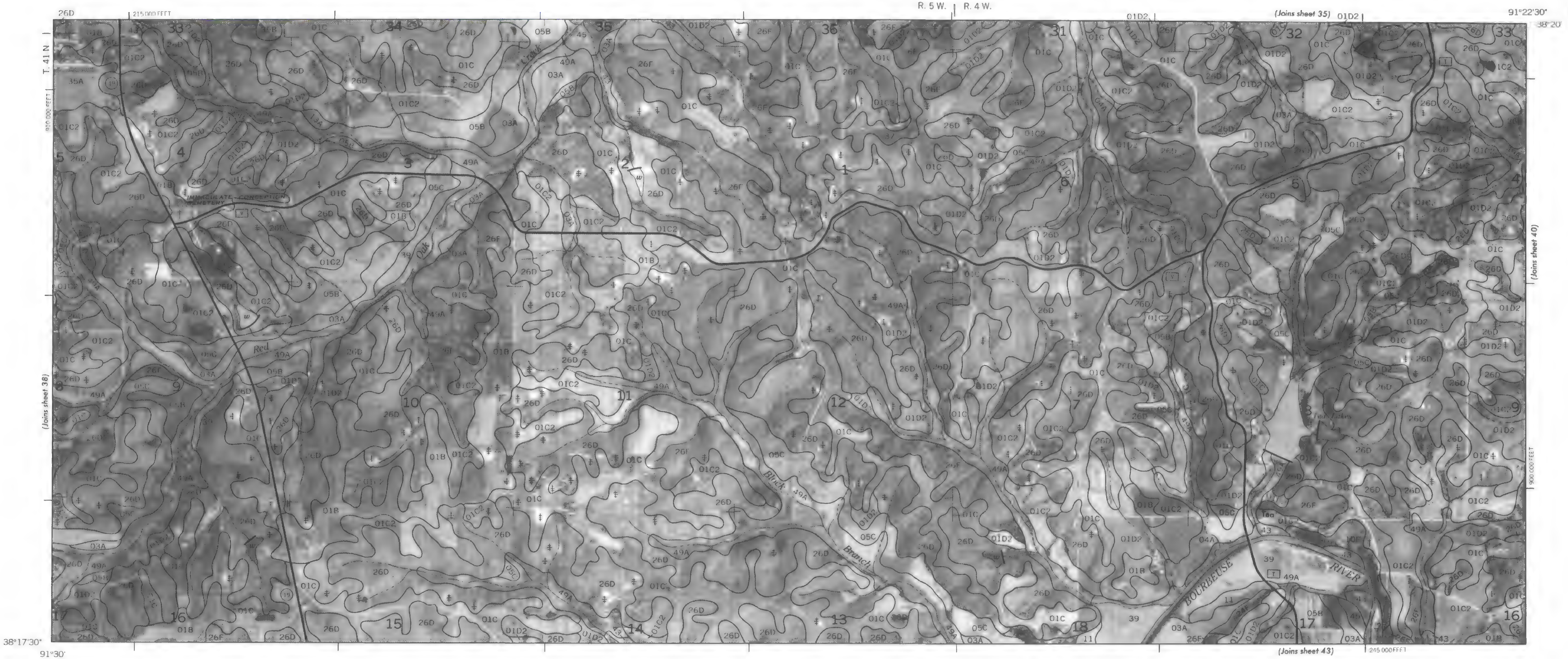
1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

Index Map Welcome Page Manuscript

39

N



1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

Index Map Welcome Page Manuscript

Index Map Welcome Page Manuscript

41

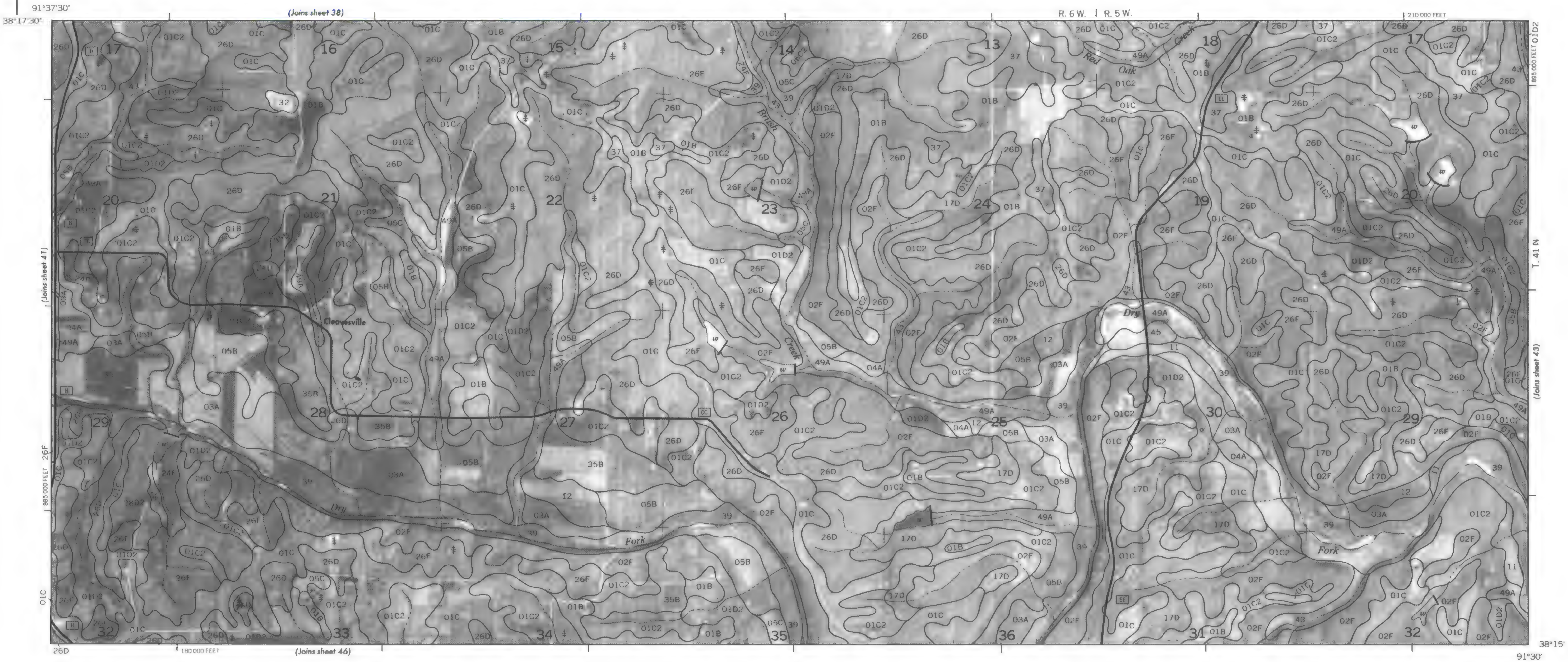
N

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

Index Map Welcome Page Manuscript



1 3/4 1/2 1/4 0 1 2 MILES

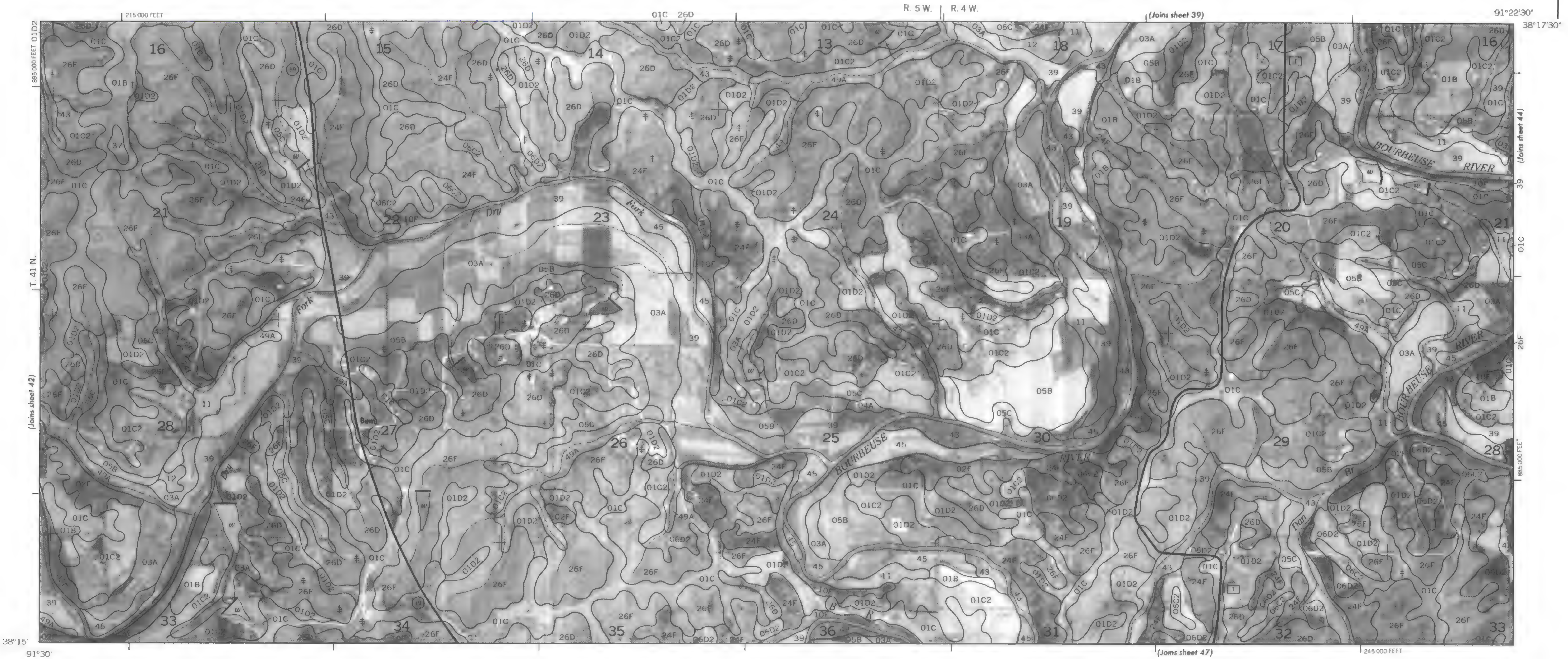
1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

Index Map Welcome Page Manuscript

43

N



1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

Index Map
Welcome Page
Manuscript

Index Map Welcome Page Manuscript

1 3/4 1/2 1/4 0 1 2 MILES

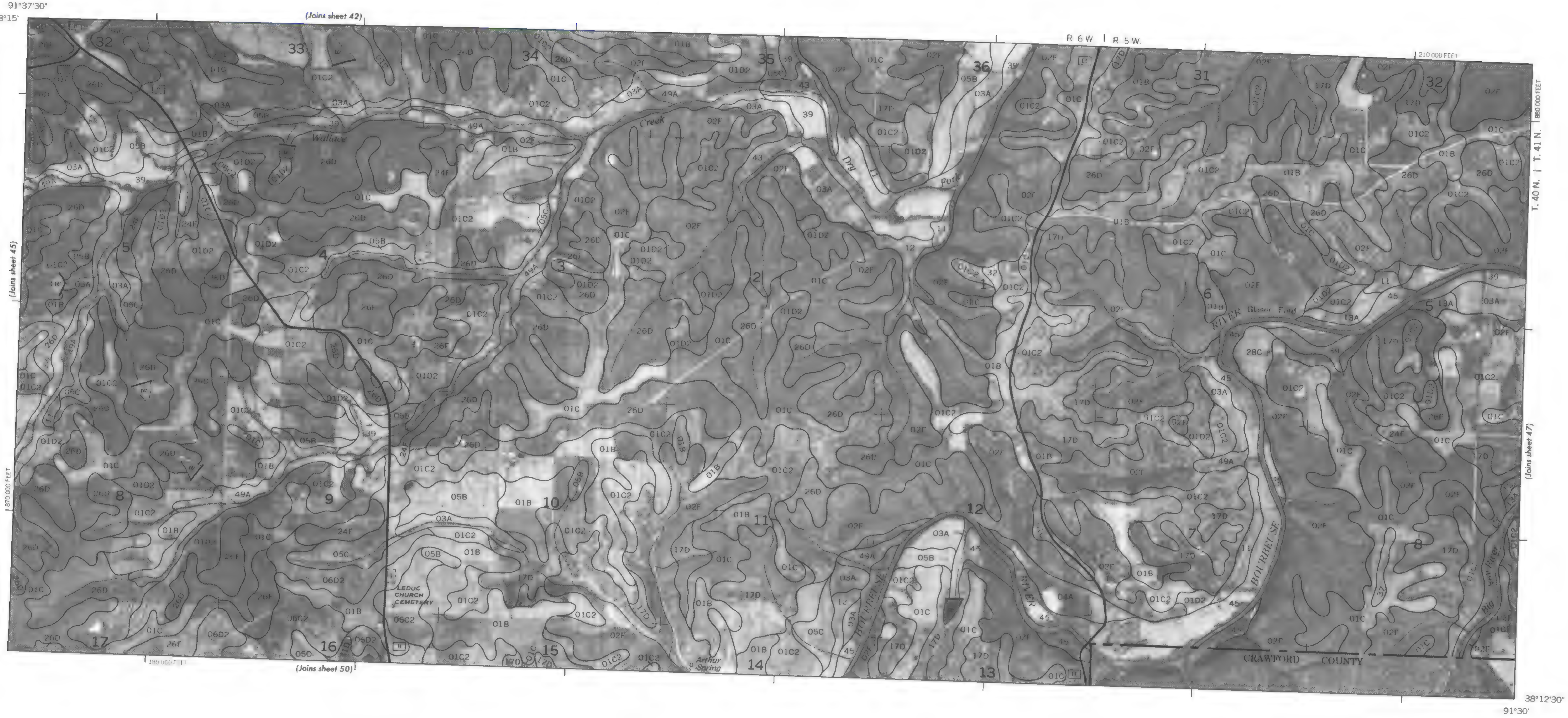
1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

46

N

Index Map Welcome Page Manuscript

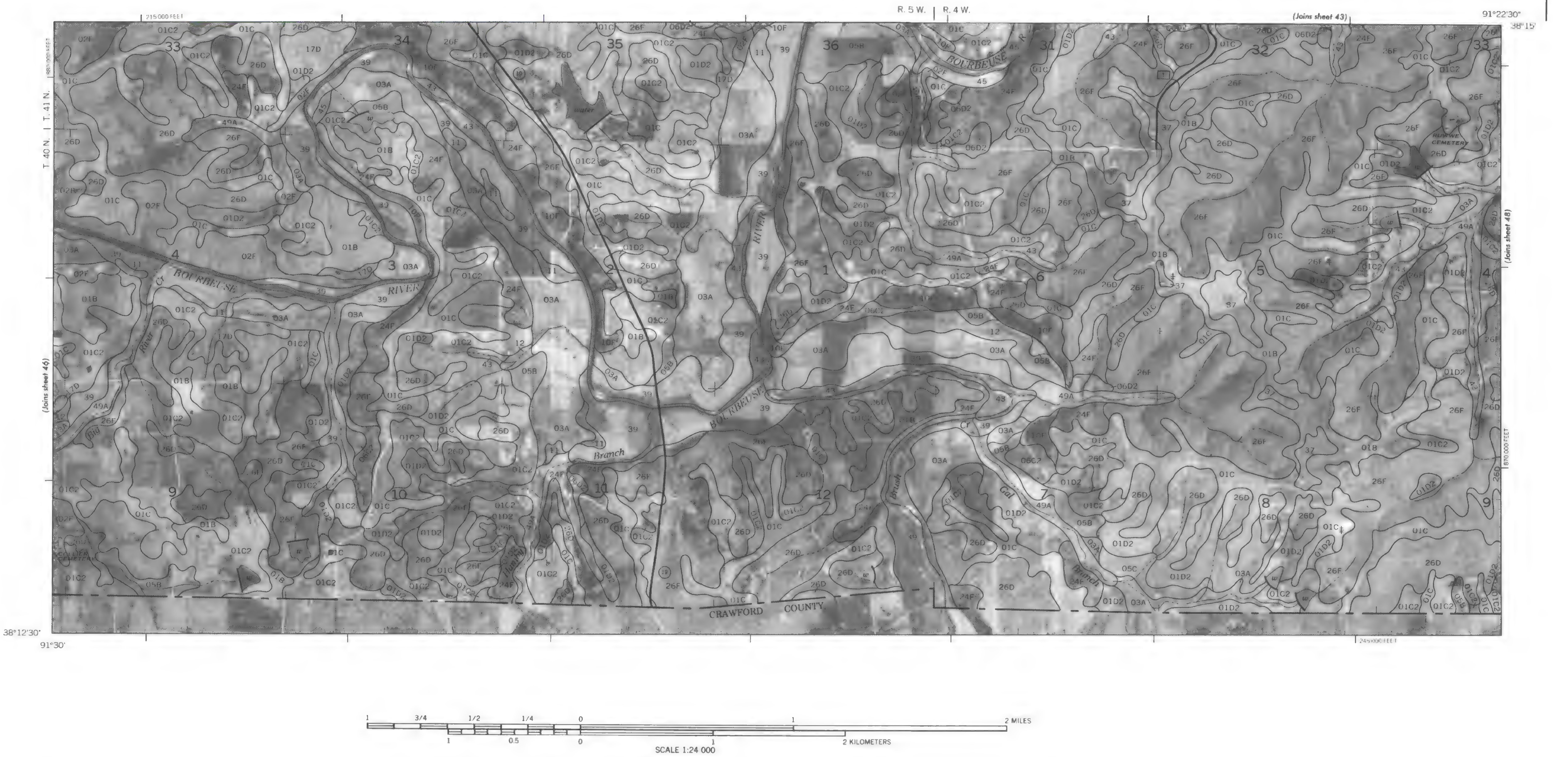


1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

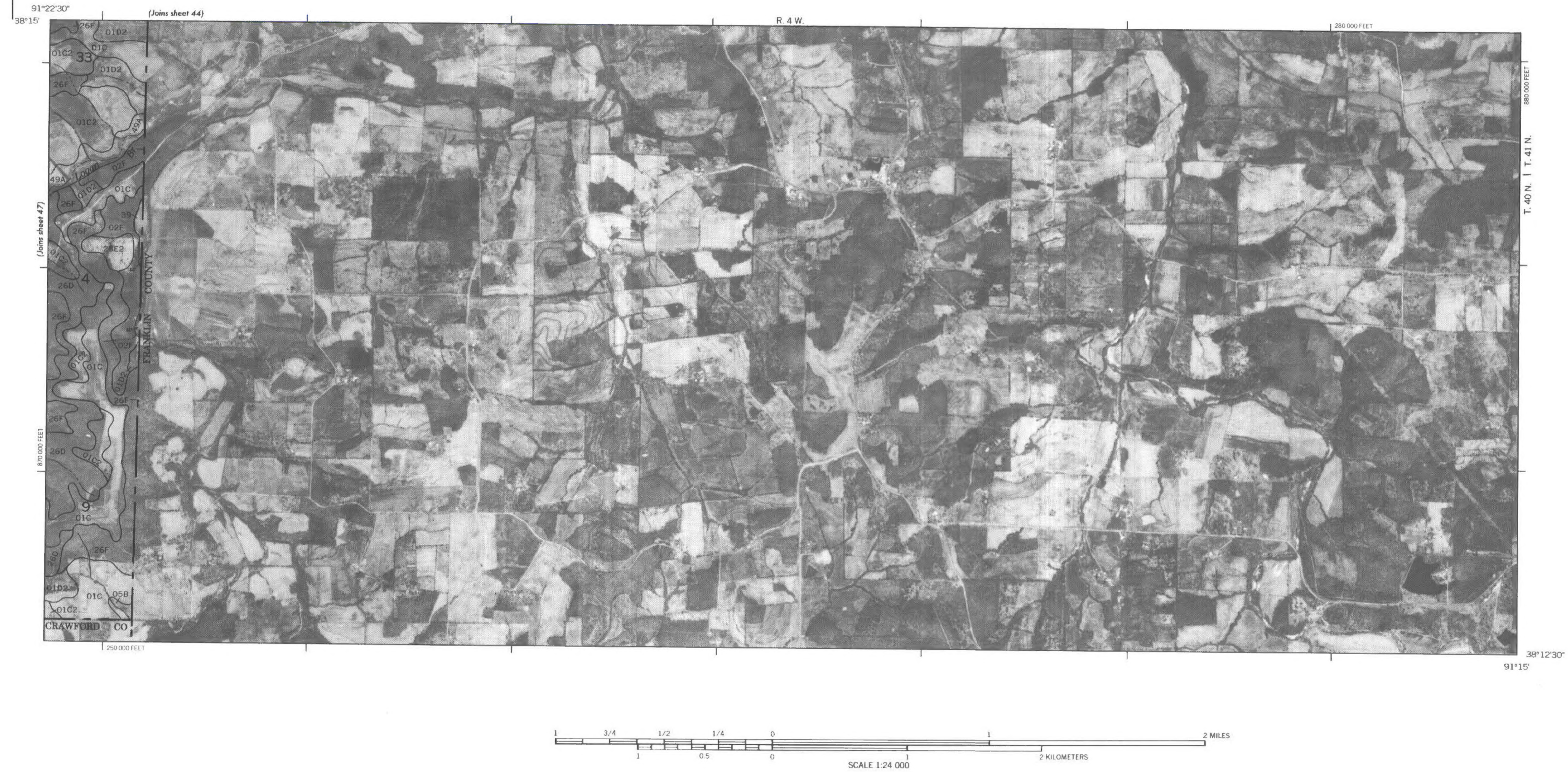
SCALE 1:24 000

Index Map Welcome Page Manuscript

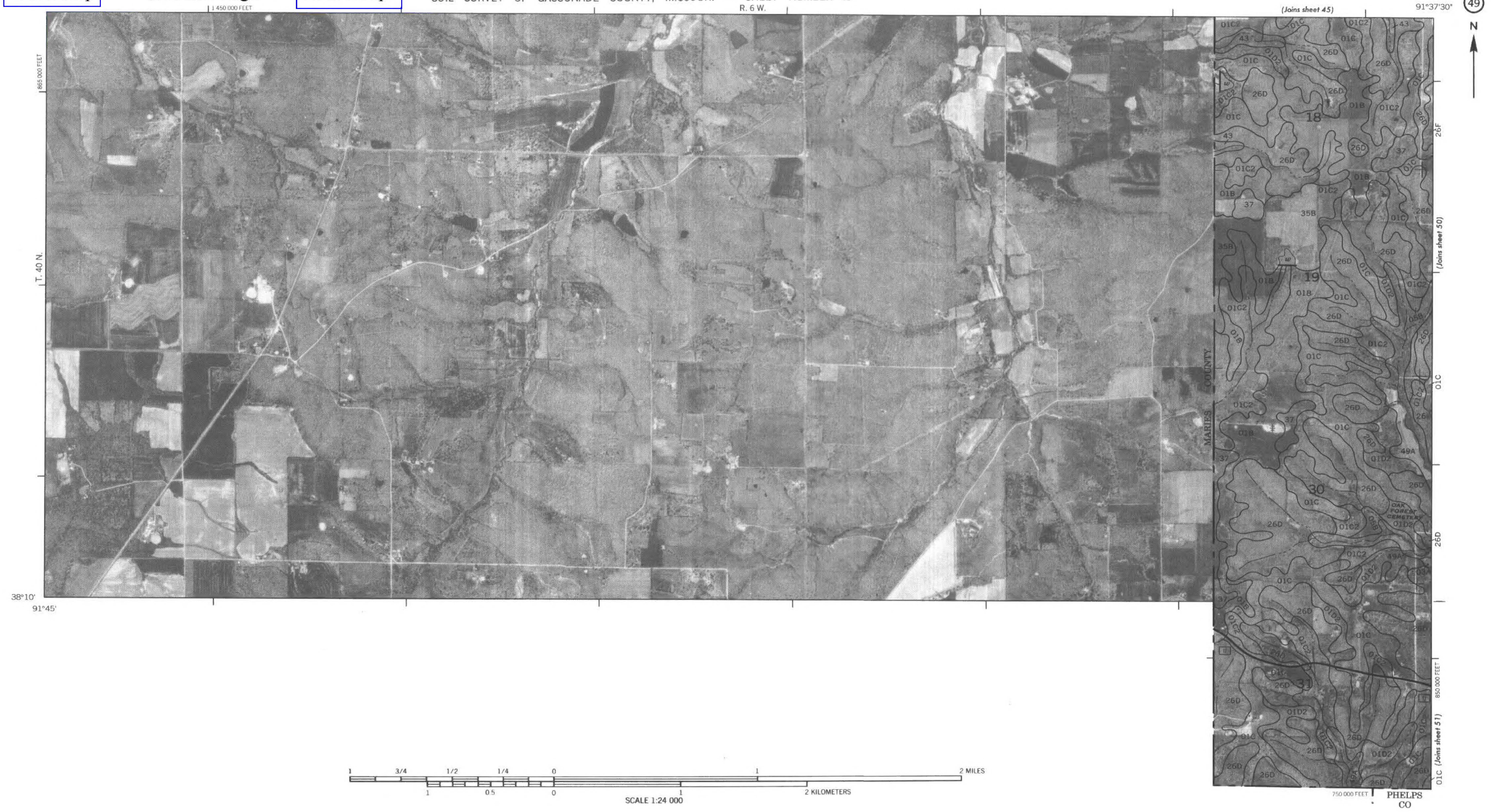


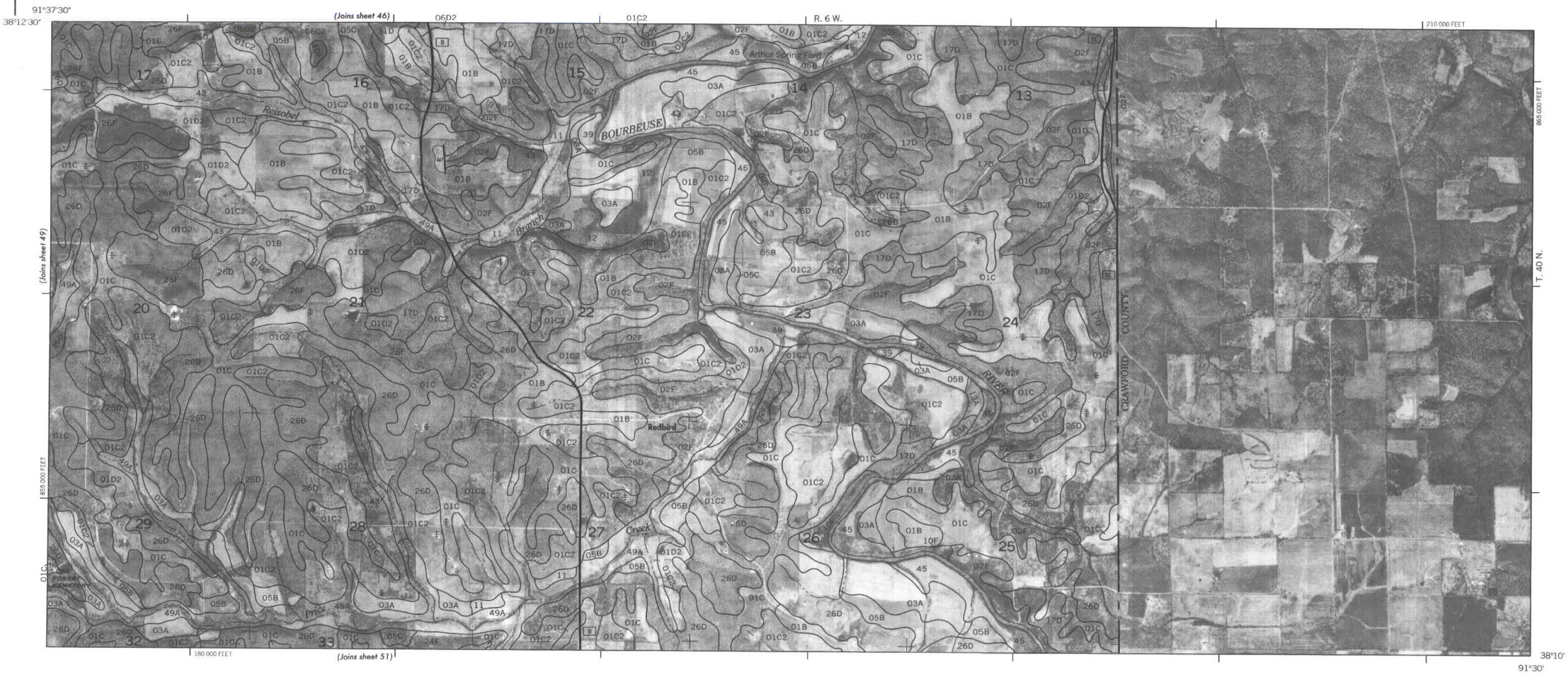
48

Index Map Welcome Page Manuscript



SOIL SURVEY OF GASCONADE COUNTY, MISSOURI — SHEET NUMBER 49





SCALE 1:24 000

Index Map Welcome Page Manuscript

SCALE 1:24 000